Kantipur Engineering College
Dhapakhel, Lalitpur

Chemistry Practice Questions 2073

Electrochemistry and Buffer (Points 10)

1. Define electrochemical cell? How does a galvanic cell differ from an electrolytic cell? What is the function of salt bridge in a galvanic cell? Write cell notation, electrode reaction and E_{cell} for a cell at 25°C having following electrodes: $E^{o}_{Zn^{++}/Zn} = -0.76$ V, $[Zn^{++}] = 1.2M$, $E^{o}_{Cu/Cu^{++}} = -0.34$ V, $[Cu^{++}] = 0.01M$.
2. How does an electrode potential originate? Define standard electrode potential and explain standard hydrogen electrode and its use. Granulated zinc is added in excess to 500 ml of 1M nickel nitrate solution at 25°C until the equilibrium is reached. If the standard reduction potential of zinc and nickel are - 0.76 and - 0.25 V respectively, find out the concentration of nickel nitrate $[Ni^{2+}]$ in the solution at equilibrium.
3. What is standard oxidation and reduction potential of an electrode? What is EMF of a cell? From the given electrode couple $E°_{Fe/Fe^{++}} = 0.44$ volt, $[Fe^{++}] = 0.5M$ and $E°_{Ag/Ag^{+}} = -0.80$volt, $[Ag^{+}] = 0.2M$. Write the (i) electrode reaction (ii) net cell reaction (iii) cell notation (iv) E_{cell} and (v) spontaneity of the cell.
4. What is corrosion? Explain the electrochemical theory of rusting. Mention some methods for its prevention.
5. What is an electrochemical series? Predict which one of the following reactions is feasible. Given $E^{o}_{Zn^{++}/Zn} = -0.76$ volt and $E^{o}_{Cd^{++}/Cd} = -0.40$ volt.
   a) $Zn^{++} + Cd \rightarrow Zn + Cd^{++}$
   b) $Zn + Cd^{++} \rightarrow Zn^{++} + Cd$
6. Define buffer solution, buffer action, and buffer capacity? Explain acidic and basic buffers with an example each. A buffer is made by mixing 400 ml of 0.3M acetic acid with 200 ml of 0.6M sodium acetate. Calculate the pH of the resulting buffer. (pK_a=4.74)
7. Derive Henderson's equation for basic buffer. To prepare a litre of a buffer solution of pH 10, how many grams of NH_4Cl has to be added to a litre of 0.25 M NH_4OH solution? Also calculate the degree of ionization of NH_4OH ($pK_b = 4.74$)
8. Write the mechanism of acidic buffer. A liter of buffer solution containing 0.1 mole acetic acid and 0.1 mole sodium acetate has pH of 4.74. Calculate the pH of solution after adding 0.02 mole of NaOH. ($k_a = 1.8x10^{-5}$)
9. Write the mechanism of basic buffer. Calculate the pH of a solution when 50 ml of 0.05 M HCl is added to 100 ml of 0.1 M NH_3 solution. ($k_b = 1.75x10^{-5}$)
10. Derive Henderson's equation for acidic buffer. How many moles of sodium acetate should be used to prepare 1200 ml of a buffer solution, which is decinormal with respect to acetic acid and has a pH of 5.2? ($pk_a = 4.74$)
11. The pH of blood stream is maintained by a proper balance of H_2CO_3 and $NaHCO_3$ concentrations. What volume of 5M $NaHCO_3$ solution should be mixed with 10 ml sample of blood which is 2 M in H_2CO_3 in order to maintain a pH of 7.4? K_a for H_2CO_3 in blood is $7.8x10^{-7}$.

Catalyst (5 or 10 points)

1. Define catalyst and catalysis? What are the criteria of catalysis?
2. Explain heterogeneous catalysis. Explain with an example the adsorption theory to account the mechanism of heterogeneous catalysis
3. Explain the following terms with example: a) negative catalyst b) auto catalysis c) promoter d) inhibitor e) contact catalysis.
4. Explain homogeneous catalysis. Explain with an example the intermediate compound formation theory to account the mechanism of homogeneous catalysis. What are the criteria of industrial catalysis?
5. Expalin the process of hydrogenation of ethene by adsorption theory. How does a catalytic poison paralyze the activity of a catalyst?

Environmental Chemistry (10 points)

1. What is air pollution? What are the main pollutants of air and their sources? Give possible remedies of air pollution.
2. Why are oxides of nitrogen and sulphur considered as air pollutants? How can we reduce such pollution?
3. Write notes on any two: a) global warming b) acid rain c) ozone layer depletion.
4. What are CFCs? Explain its photolytic reactions in the upper atmosphere. Give its consequences and possible remedies.
5. Point out major pollutants of water. Mention their affects on living beings and give their possible remedies.
6. What is soil pollution? Point out major soil pollutants, their affects and possible remedies.
7. Explain green house effect and global warming. What are the major green house gases and their sources? Mention some adverse effects of global warming and measures that should be taken to reduce it.

8. Answer any two
   i) Point out the sources of radioactive substances responsible for environmental pollution and their adverse effects and remedies.
   ii) Briefly discuss any two sources of organic and inorganic substances responsible for water pollution. Mention their remedies.
   iii) How do exhausts of internal combustion engine pollute air? Give possible remedies to reduce them.

Engineering Polymers (10 points)

1. Define inorganic polymer. Mention the properties of inorganic polymer.
2. What is a linear chain polymer? Write the preparation and uses of different types of sulphur based polymer.
3. What are polyphosphonitrilic compounds? Give the method for the preparation of polyphosphonitrilic compound and mention the uses.
4. Write the method of preparation of polydimethoxy phosphozine and polydiethoxy phosphozine.
5. What are Chalcogenide glasses? Mention their uses.
6. What are silicones? Give any two uses of silicones
7. Describe about the types of silicon polymer along with their uses.
8. What is biodegradable polymer? Write the method of preparation and two important uses of each of bakelite, polyurethane and epoxy resin. What are the advantages of conducting polymers in engineering?
9. What are thermosetting and thermoplastic polymers? Give examples.
10. Write short notes on: a) polystyrene b) polyvinylchloride c) Teflon d) nylon6,6

3d Transition elements and their applications (10 points)

1. Write the general outer electronic configuration of transition element.
2. Give reasons why transition elements are paramagnetic and show catalytic properties. Why the compounds of transition elements are coloured?
3. Give reasons why Zn and Cd are not considered as typical transition metals.
4. Explain the following features of transition elements with reference to 3d transition series.
   a. Variable oxidation states
   b. Formation of complex compound.
5. Explain why compounds of V^{+5} are colourless but those of V^{+3} are coloured.
6. Explain why transition elements are good for alloy formation.
7. Show your acquaintance with the applications of 3d transition elements.
8. Explain the main characteristics of 3d transition elements
9. Explain why TiO_2 is white but $TiCl_3$ is violet.
10. What are d block elements? Mention which d block metals are not considered as true transition metals and why? Mention the general features of transition elements.

Coordination complexes (10 points)

1. Differentiate between complex salts and double salts. Write the basis assumptions of Werner's theory of coordination compounds.
2. How does valence bond theory explain the formation of $[Ni(NH3)_6]^{2+}$ Predict its magnetic behaviour.
3. Write the postulates of valance bond theory with its limitations. Explain the formation of $[Ni(CO)_4]^0$ complex on the basis of VBT. Also predict its geometry and magnetism with explanations.
4. What do you understand by the principal and auxillary valencies of the metal ion in the complex compounds. Illustrate them in the following complexes:
   a. $[Co(NH_3)_6]Cl_3$ b. $K_4[Fe(CN)_6]$ c. $[Co(NH_3)_2(en)_2]Cl_3$ d. $[Cr(NO_3)_6]^{3-}$
5. Explain the formation of following complex on the basis of VBT. Also explain their magnetic behavior.
   a. $[NiCl_4]^{2-}$ b. $[Ni(CO)_4]^0$ c. $[Ni(CN)_4]^{2-}$ d. $[Co(CN)_4]^{2-}$ e. $[Fe(CN)_6]^{4-}$ f. $[Fe(CN)_6]^{3-}$ g. $[FeF_6]^{3-}$ h. $[Ni(NH_3)_6]^{2+}$
6. Differentiate between high spin and low spin complex and mention the applications of complex compounds.
7. Explain Sidgwicks concepts of coordinate compounds. What is Sidgwick EAN (Effective Atomic Number). Calculate EAN value of :
   a. $[Co(NH_3)]^{3+}$ b. $[FeCl_4]^-$ c. $[Cu(CN)_4]^{3-}$ d. $[Ni(en)_3]^{2+}$
8. Write the IUPAC name of the following complexes.
   a. $K_2[HgI_4]$ b. $K_4[Fe(CN)_6]$ c. $[Co(NH_3)_5Cl]^{2-}$ d. $Li[AlH_4]$ e. $[Al(OH)(H_2O)_5]^{2+}$

f. $K[Ag(CN)_2]$ g. $[Co(NH_3)_2(en)_2]Cl_3$ h. $[CoClCNNO_2(NH_3)_3]$ i. $[Cr(NO_3)_6]^{3-}$ j.$Na_3[Al(C_2O_4)_3]$

g. Write the formula of the following complex compounds.

a. Potassium hexacyanoferrate(III) b. trioxalatoaluminate(III)ion c. bis(benzene)chromium(0)
d. tris(ethylenediammine)chromium(III)chloride e. dibromotetraaquachromium(III)chloride
f. Potassium hexacyanocobaltate(II) g. Tetraaminedichlorocobalt(III) h. sodiumtrioxalatoaluminate(III)
i. diammine silver(I)iodide j. hexaaqua iron(III)chloride

Explosives (5 points)

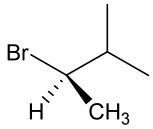
1. What are explosives? Differentiate between primary, low, and high explosives with examples and uses.
2. Write the methods of preparation, properties, and uses of TNT, TNG, Nitrocellulose and plastic explosives.

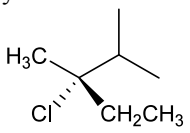
Lubricants and Paints (5 points)

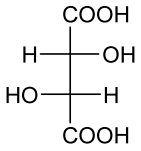
1. Define lubricants and lubrication. Explain why lubricants are important.
2. Define paints. What are the requisites of a good paint? Show your familiarity with the types of paints.
3. Explain the following: a) lubricating oil and their types b) grease c) solid lubricants
4. Write short notes on: a) varnishes b) enamels c) lacquers d) emulsion paints

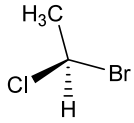
Stereochemistry (5 or 10 points)

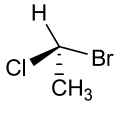
1. Define: Optical isomer, chirality, optical activity, and specific rotation.
2. Explain: "All the enatiomers are stereoisomers but all the stereoisomers are not enantiomers".
3. Write the difference between enantiomers and diastereomers. Write all the possible stereoisomers of HOOC-CHOH-CHOH-COOH, with their Fischer Projection Structure. Differentiate enantiomers, diastereomers, and meso compounds from the structures. Find the asymmetric carbon in the given compounds and determine its configuration (*R* or *S*)



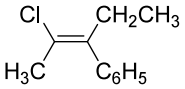


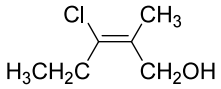


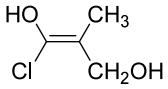


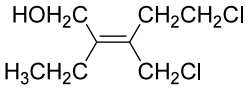


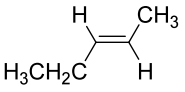
4. What is geometrical isomerism? Find of E or Z isomers from the following compounds.

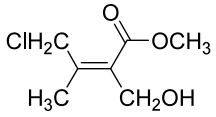


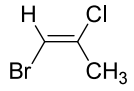












5. Write all possible stereoisomers of a compound that contains two asymmetric carbons and:
   (a) also has a meso form,
   (b) does not have meso form

Reaction Mechanism in Organic Chemistry (5 or 10 points)

1. Explain S_N1 and S_N2 reaction mechanisms with suitable examples.
2. Describe the factors affecting S_N1 and S_N2 reactions.
3. Explain the reaction mechanism involved when 2-bromobutane reacts with alcoholic KOH.
4. Explain the mechanism involved in the following reactions:
   a) Hydrolysis of methyl bromide by aqueous sodium hydroxide.
   b) Dehydrohalogenation of tertiary butyl bromide by alcoholic sodium hydroxide.
   c) Why tertiary butyl bromide undergo S_N1 reaction but methyl bromide undergoes S_N^2?
   d) S_N^1 reaction gives both retention and inversion of products but S_N^2 reaction gives inversion product only.
   e) How can you prove that the carbocation is not formed during S_N^2?
5. Explain E1 and E2 reaction mechanisms with suitable examples.

"A dream doesn't become reality through magic; it takes sweat, determination and hard work. – Colin Powel"