RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. FOURTH SEMESTER EXAMINATION, MAY-JUNE 2013
SECOND YEAR

Date : 23/05/2013   **Chemistry (General)**

Time : 11am – 2pm   Paper : IV   Full Marks : 75

Group-A

Unit-I
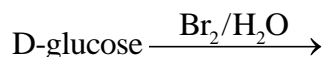
Answer any **three** questions

1. a) Explain why RCOOH is more acidic than R–OH [R is an alkyl group].   1
   b) Prepare (i) Me_3CCOOH and (ii) $HOCH_2CH_2CH_2COOH$ from alkyl halides.   2
   c) Write mechanism for the reaction $RCOOR'$ with aqueous $\bar{O}H$ to form $RCO\bar{O}$ and $R'OH$.   2

2. a) In terms of resonance and inductive effects, account for the following relative acciditives.   2
   $$p–O_2NC_6H_4OH > m–O_2NC_6H_4OH > C_6H_5OH$$
   b) Write down the products for the following reactions: 3

   (i) $C_6H_5O^-Na^+ + O=C=O \xrightarrow[6\,atm]{125°C} A \xrightarrow{H_3O^+} B$

   (ii) $C_6H_5OH + CHCl_3 + \bar{O}H \longrightarrow C$

   (iii) $PhOCOCH_3 \xrightarrow[\Delta]{AlCl_3} D + E$

3. a) How is Griguard reagent prepared and what precautions must be taken during its preparation?   2
   b) Using suitbale RMgX prepare the following: 3

   (i) $CH_{3\,3}COH$, (ii) $PhCH_2COOH$, (iii) 2–pentyne

4. a) Using Gabriel method synthesize benzylamine.   1½
   b) Write notes on reduction of aromatic nitro compounds.   2
   c) Distinguish $C_2H_5NH_2$ and $(C_2H_5)_2NH$.   1½

5. Prepare following compounds (any three):   5
   (i) m-nitrophenol from nitrobenzene
   (ii) Picric acid (or 2,4,6-tinitrophenol) from phenol
   (iii) m-bromochlorobenzene from nitrobenzene
   (iv) 2,4,6-trinitrotoluene from benzene.

Unit-II

Answer any **two** questions

6. a) Carry out the following conversion—
   D-glucose $\longrightarrow$ D-avabinose   3
   b) What happens when glycine is treated with Benzoyl Chloride.   2

7. a) Write a short note on osozone formation.   3
   b) Predict the product of the following reaction

   $\alpha–D–glucopyranose \xrightarrow[HCl/\Delta]{MeOH(1eq)}$ 2

8. a) Carry out the following conversion
   Phthalimide $\longrightarrow$ Alanine   3

b) Predict the product of the following reaction

D-glucose $\xrightarrow{\text{Br}_2/\text{H}_2\text{O}}$

2

Group-B
Unit-I

Answer any **three** questions

9. A reversible engine has the following steps
   (i) Isothermal compression (P_1, V_1 to P_2, V_2)
   (ii) Adiabatic compression (P_2, V_2 to P_3, V_3)
   (iii) Isothermal expansion (P_3, V_3 to P_4, V_4)
   (iv) Adiabatic expansion back to the initial state (P_4, V_4 to P_1, V_1)
   a) Indicate the entire process in a P–V diagram.   2
   b) Calculate the efficiency of the engine.   3

10. a) Write down the Thermodynamic definition of entropy.   1
    b) What is the sign of entropy change in a spontaneous process within an isolated system.   1
    c) In a process with one mole of a monoatomic ideal gas, both the temperature and volume get doubled. Calculate the entropy change for the process.   3

11. a) With the help of its molecular interpretation explain whether entropy increases / decreases in the following process –
    (i) Melting of ice
    (ii) Decomposition of water into hydrogen and oxygen   2
    b) Starting with the Clausius Inequality prove that for a spontaneous process at constant temperature and pressure $\Delta G < 0$.   3

12. a) State and explain "Schulze-Hardy rule" for the coagulation of colloids.   3
    b) Arrange the following in increasing order of flocculation value for negative sol.
    $MgCl_2$, $Al_2(SO_4)_3$, Na_3PO_4.   2

13. a) "Isoelectric point of gelatine is 4.7" – what does it mean?   2
    b) Write short notes on (any two):   1½+1½
    (i) Peptization (ii) Tyndall effect (iii) Dialysis

Unit-II

Answer any **two** questions

14. a) A general chemical reaction is given us $\nu_A A + \nu_B B \rightarrow \nu_M M + \nu_Q Q$.

    (i) Explain what do you mean by the order of the reaction.   1½
    (ii) If it were a single step process what would have been the value of its molecularity?   1½
    b) Arrive at the integrated form of the rate law for a general first order reaction.   2

15. a) What is an auto-catalytic reaction? Give one example.   3
    b) Which of the following will not change due to the addition of a catalyst at a particular temperature.
    (i) Equilibrium constant (ii) Rate constant   2

16. a) Write down Arrhenius equation for the temperature dependence of reaction rate.   2
    b) How can you determine the activation energy of a chemical reaction with the help of Arrhenius equation?   3

Group-C

Unit-I

Answer any **three** questions

17. a) State and explain Lewis acid-base theory.   3

    b) How many grams of NaOH must be present in one litre of solution to give a pH of 12.   2

18. a) What is Buffer solution? Explain Buffer action.   4

    b) Which of the following pairs will act as buffer?   1

    $NH_4NO_3 + NH_4OH$; $CH_3COOH + CH_3COONa$; $NaOH + CH_3COONa$

19. a) Deduce an expression for the pH of a solution of salt of weak base and strong acid.   3

    b) An aqueous solution of NaCl is neutral, that of $(NH_4)_2SO_4$ is acidic and that of CH_3COONa is alkaline – explain.   2

20. a) Establish a relation between specific conductance and equivalent conductance.   2½

    b) Specific conductance of a strong electrolyte decreases with dilution whereas equivalent conductance increases with dilution – explain.   2½

21. a) What is cell constant? What is its unit?

    If we use two cells with different cell constants then which of the following will change?   3

    (i) Conductance   (ii) Specific conductance   (iii) Equivalent conductance

    b) Arrange the following substances in under of increasing value of their equivalent conductance at infinite dilution.

    (i) KCl   (ii) KOH   (iii) CH_3COOH 2

Unit-II

Answer any **two** questions

22. a) Write down the Nernst' equation for an electrochemical reaction, explaining each term that appears.   2

    b) What do you mean by normal hydrogen electrode?   2

    c) Write down the cell reaction that is involved in the Calomel electrode.   1

23. a) Define 'osmosis' and 'osmotic pressure'.   2

    b) i) Arrange the following solution in order of the increasing value of the freezing point of water. (mention if they are equal)

      0.1 M   NaCl, 0.1 M $Al_2(SO_4)_3$, 0.1 m sugar.

    ii) Explain your answer.   1+2

24. a) i) Mention the expression that relates the concentration of a solution (in molality) and the amount of depression of freezing point of the solvent in the solution compared to that in the pure state. (assume the solution to be ideal)   1

    ii) Under which condition the above expression is valid for the real solutions.   1

    b) i) Depict how the osmotic pressure and gas pressure obey same type of equations.   1½

    ii) Further, explain how the phenomena, of gas exherting pressure on its walls may be compared to the origin of osmotic pressure in solutions.   1½

ജ❈ය