QUESTIONBANK

TitleofthePaper

GENERAL CHEMISTRY-IV

Course: II YEAR

Preparedby

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Bharathidasan university syllabus

SEMESTER-VI

B.Sc –CHEMISTRY

GENERAL CHEMISTRY – IV

UNIT I d-BLOCK & f-BLOCK ELEMENTS

1.1 General characteristics of d-block elements, comparative study of zinc group elements, extraction of Mo & Pt - Alloys of copper, amalgams and galvanization. Evidencesfortheexistenceof☐22Hgions.
1.2 General characteristics of f-block elements – Lanthanide contraction andits consequences. Extraction ofTh.
 1.3 Arrhenius, Lowry – Bronsted and Lewis concept of acids andbases.

UNITIICHEMISTRYOFORGANOMETALLICCOMPOUNDS

2.1 Introduction – preparation of organomagnesium compounds- physical and chemical properties- uses. Organozinc compounds – general preparation, properties and uses.
2.2. Organolithium, organocopper compounds – preparation, properties anduses.
2.3. Organolead, organophosphorous and organoboron compounds– preparation, properties anduses.

UNIT III CHEMISTRY OF ALCOHOLS, PHENOLS AND ETHERS

3.1Nomenclature – industrial source of alcohols – preparation of alcohols: hydration of alkenes, oxymercuration, hydroboration, Grignard addition, reduction – physical properties – chemical properties - uses – glycols from dihydroxylation, reduction, substitution reactions and glycerols and their uses. 3.2Preparation of phenols including di- and trihydroxy phenols – physical and chemical properties - uses – aromatic electrophilic substitution mechanism – theory of orientation and reactivity.
3.3Preparationofethers:dehydrationofalcohols,Williamson'ssynthesis–silylether. epoxidesfromperacids-sharplessasymmetricepoxidation–reactionsofepoxides– uses–introductiontocrownethers–structures–applications.

UNIT IV THERMODYNAMICS-I

4.1. Definitions- system and surrounding- isolated, closed and open system- state of the system- Intensive and extensive variables. Thermodynamicprocesses-
15 reversible and irreversible, isothermal and adiabatic processes- state and path functions.
4.2. Work of expansion at constant pressure and at constant volume. First law of thermodynamics- statement- definition of internal energy (E), enthalpy (H) and heat capacity. Relationship between Cp andCv.

4.3. Calculation of w, q, dE and dH for expansion of ideal and real gases under isothermal and adiabatic conditions of reversible and irreversibleprocesses.

4.4. Thermochemistry-relationshipbetweenenthalpyofreactionatconstantvolume(qv) andatconstantpressure(qp)-temperaturedependenceofheatofreaction-Kirchoff's equation- bond energy and its calculation from thermochemical data- integral and differentialheatsofsolutionanddilution.

UNIT V CHEMICAL KINETICS

5.1. Rateofreaction-rateequation,orderandmolecularityofreaction.RateLaws-rate constants-derivationoffirstorderrateconstantandcharacteristicsofzeroorder,first order and second order reactions- derivation of time for half change (t1/2) with examples.

5.2. Methods of determination of order of reactions- experimental methods- determinationofrateconstantofareactionbyvolumetry,colorimetryandpolarimetry.

5.3. Effectoftemperatureonreactionrate-conceptofactivationenergy,energybarrier, Arrhenius equation. Theories of reaction rates- collision theory- derivation of rate constant of bimolecular reaction- failure of collision theory- Lindemann's theory of unimolecularreaction.

5.4. Theory of absolute reaction rates – derivation of rate constant for a bimolecular reaction-significanceofentropyandfreeenergyofactivation.Comparisonofcollision theoryandabsolutereactionratetheory(ARRT).

Unit-I

CHOOSE THE CORRECT ANSWER

1. Which one of the following metal ions is not colored?
   a. V3+
   b. Ti3+
   c. V2+
   d. Cu2+

2. Transition metals:
   a. Exhibit inert pair effect
   b. exhibit variable oxidation state
   c. Have low melting point
   d. do not show catalytic activity.

3. Which electronic configuration of Cr and Cu is correct?
   a. $d^4 s^2, d^9 s^2$
   b. $d^5 s^1, d^{10} s^1$
   c. $d^5 s^2, d^{10} s^2$
   d. $d^6 s^1, d^8 s^2$

4. which of the following forms a stable +4 oxidation state:
   a. La
   b. Eu
   c. Gd
   d. Ce

5. All the lanthanides exhibit a valency of:
   a. 3
   b. 4
   c. 2
   d. 6

6. Among the lanthanides the one obtained by synthetic method is:
   a. Lu
   b. Pr
   c. Pm
   d. Gd

7. When an acid reacts with a metal, which one of the following gas is usually liberated?
   a. Ammonia gas
   b. chlorine
   c. oxygen
   d. Hydrogen gas

8. Select the one which is neither an acid nor base
   a. CH_3COOH
   b. HCl
   c. KCl
   d. CH_3OH

9. Strong bases are
   a. strong electrolytes.
   b. weak electrolytes.
   c. Non electrolytes
   d. also strong acids.

10. Whose definition of acids and bases emphasizes the role of protons?
   a. Brønsted and Lowry
   b. Lewis
   c. Arrhenius
   d. Faraday

Answers 1 (c), 2 (b), 3 (a), 4 (d), 5 (a), 6 (a), 7 (d), 8 (b), 9 (d), 10 (b)

SHORT QUESTIONS (2 MARKS)

11. What are transition elements?
12. Give electronic configuration of d-block elements? How are they sub divided in the various serious?
13. List the properties associated with transition elements.
14. Define ionization energy?
15. What are inner transition elements?
16. What are lanthanides and actinides? Why they are called?
17. General electronic configuration of lanthanides and actinides?
18. Define Lewis acids and bases.
19. Define Conjugate acids and bases.
20. Classify, giving reasons, the following concepts as Lewis acids and bases:
   (i) BCl_3 (ii) Br- (iii) C_2H_5OH (iv) Cu^{2+}

PARAGRAPH QUESTIONS (5MARKS)

21. Give electronic configuration of the following elements and ions:(i) Atomic numbers 29, 42 and 57,(ii)Ti^{3+}(Atomic number 22); S^{2-}(Atomic number16); Cu^{2+}(Atomic number 29).
22. "Compounds of S and P block elements are generally colourless (i.e., white)but those of transition metals are generally coloured". How would you explain this behavior?
23. Alloys of copper, amalgams and galvanization.
24. Discuss the important characteristic of lathanides.
25. Name the actinide elements in their correct order, and give their chemical symbols.
26. How do the atomic radii of lanthanides vary? Explain the reason.
27. Discuss about oxidation states of actinides.
28. Account for the difficult for separation from the lanthanides from one another? Why is the separation of lanthanides difficult?
29. Discuss the magnetic properties of actinides.
30. Account for the close similarity in the properties of lanthanide elements and their compounds.

ESSAY QUESTIONS (10 MARK)

31. How do the following properties vary in the transition elements?
    (i) Ionic properties
    (ii) Basic properties
    (iii) Stability of the various oxidation states
    (iv) Ability to form complexes?
32. Evidences for the existence of ^{22}Hg-ions
33. Explain giving reasons why:
    (i) Most of the transition metals are paramagnetic
    (ii) Iron, cobalt and nickel are ferromagenetic
    (iii) Compounds of transition metals are generally coloured.
    (iv) All transition metals exhibit variable valency.
34. What is lanthanide contraction and what are its causes and consequences?
35. Describe the extraction of thorium from monazite and mention some of its properties   and uses.
36. Compare and contrast the pyramid of oxidation states found in the first row of the transition elements with the oxidation states found in lanthanides and in the actinides.
37. Compare the chemistry of lanthanide elements with that of actinides and account for the difference.
38. How will your account for the different oxidation states of lanthanide ions and magnetic properties of lanthanides?

39. Account for the fact it is difficult to separate the lanthanides from one another? Why is the separation of lanthanides difficult?

40. Describe briefly the methods used for the separation of lanthanides.

UNIT-II

CHOOSE THE CORRECT ANSWER

1. Li react with alkyl halide to give
   a. Lithium alkyl
   b. Lithium aryl
   c. Alkyl halide
   d. Lithium halide

2. Lithium alkyls are
   a. Trimeric
   b. Monomeric
   c. Polymeric
   d. Dimeric

3. The general formula of grinard reagent is
   a. $RMgX_2$
   b. RMg_2X_3
   c. $RMgX$
   d. R_2MgX

4. The reactivity order of grinard reagent is
   a. RBr>RI>RCl
   b. RI>RBr>RCl
   c. RCl>RI>RBr
   d. RCl>RBr>RI

5. The general formula of organocopper reagent is
   a. R_2Cu
   b. R_3Cu
   c. RCu
   d. R_4Cu

6. The general formula of organozinc reagent is
   a. $RZnX_2$
   b. $RZnX$
   c. R_2ZnX_2
   d. R_2ZnX

7. Zinc is
   a. Less electronegavitive
   b. Less electropositive
   c. High electropositive
   d. High electronegative

8. Iodomethylzinc iodide is
   a. Epoxides
   b. Grinard reagent
   c. Simmons Smith reagent
   d. Willisons reagent

9. Good solvents for preparing organometallic reagents include all but?
   a. Hexane
   b. Diethylether
   c. THF
   d. Water

10. Organomagnesium compounds
   a. Acids
   b. Bases
   c. Oxidizing agents
   d. Solvents

Answers 1 (a), 2 (c), 3 (a), 4 (b), 5(c), 6(d), 7(a), 8(c), 9 (d), 10 (b).

SHORT QUESTIONS (2 MARK)

11. Give are general method of their preparation of organometallic compounds?
12. How will you prepare organo copper compounds?
13. What are organomettalic compounds?
14. Give one preparation of organo lead compounds?
15. What are the applications of grinard reagents?
16. Explain the classification of organomettalic compounds?
17. How will you prepared organo lithium compounds?

18. Explain properties of oragozinc compounds?
19. What is of grinard reagents?
20. What are the uses of organolead compounds?

PARAGRAPH QUESTION (5 MARK)

21. Explain the following reactions of organozinc compounds with equations
    i. Addition of carbonyl compounds
    ii. Reformatsky reaction
22. Discuss the preparations and properties of organoboron compounds.
23. Using methylmagnesiumiodide how will you prepare a primary, secondaryand tertiary alcohol?
24. Write short note on organolithium reagents.
25. How organolead and organoboron compounds are prepared?
26. Explain prepare and properties of organo phosphorous compounds?
27. Explain the structure of any four organometallic compounds.
28. Explain the structure and bonding of organocoppercompounds.
29. Explain preparation, properties and uses of organoleadcompounds?
30. Discuss about structure of organoboroncompounds?

ESSAY QUESTION (10 MARK)

31. Explain the preparation, properties and application of Grignard reagents?
32. Discuss the chemistry of organozinc and organo phosphorous compounds?
33. Describe any five chemical reactions of organoboroncompounds?
34. Detail about synthesis, structure and uses of organo lithiumcompounds
35. Explain preparation, properties, structure and application of organo leadcompounds.
36. Derive the synthesis, physical and chemical properties of organo boroncompounds.
37. Explain the structure of boron compounds.
38. Write notes on either alkyne complexes or cyclopentadiene complexes.
39. Explain briefly the salient features of the structure of the Zeise's salt and ferrocene.
40. Explain the bonding between ethylene and acetylene fromorganometallic compounds.

UNIT-III
CHOOSE THE CORRECT ANSWER

1. The heating of phenylmethylether with HI produces
   a. Iodobenzene
   b. Phenol
   c. Benzene
   d. Ethylchloride

2. Which compound is predominantly formed when phenol is allowed to react with bromine in aqueous medium?
   a. Picric acid
   b. O-Bromo phenol
   c. 2, 4,6-Tribromophenol
   d. p-Bromo phenol

3. Phenols are more acidic than alcohols because
   a. Phenoxide ion is stabilized by resonance
   b. Phenols are more soluble in polar solvents
   c. Phenoxide ion does not exhibit resonance
   d. Alcohols don't lose H atoms at all

4. Which of the following reagents cannot be used to distinguish between phenol and benzyl alcohol?
   a. $FeCl_3$
   b. Litmus soln
   c. Br_2/CCl_4
   d. All of these

5. 1-propanol and 2-propanol can be best distinguished by
   a. Oxidation with $KMnO_4$ followed by reaction with Fehling solution.
   b. Oxidation with acidic dichromate followed by reaction with Fehling solution.
   c. Oxidation with concentrated H_2SO_4 followed by reaction with Fehling solution.
   d. Oxidation by heating with copper followed by reaction with Fehling solution.

6. The correct order of boiling point of primary (1°), secondary (2°) and tertiary (3°) alcohols is
   a. 1°>2°>3°
   b. 3°>2°>1°
   c. 2° > 1° > 3°
   d. 2° > 3° > 1°

7. The number of carbon atoms present in a molecule of a mixed ether is
   a. always even
   b. always odd
   c. either even or odd
   d. unpredictable

8. Ether and alcohols are
   a. position isomers
   b. chain isomers

c. functional isomers
d. stereisomers

9. The oxygen atom in ether is
  a. Very active
  b. replaceable
  c. comparatively inert
  d. active

10. Which of the following is used in preparation of Bakelite polymer?
  a. phenol
  b. ethanol
  c. O-nitrophenol
  d. P-bromophenol

Answers 1.(b), 2 (c), 3 (a), 4 (c), 5 (d), 6 (a), 7 (c), 8 (b), 9 (c), 10 (a)

SHORT QUESTIONS (2 MARK)

11. How are alcohols prepared by the hydration of olefins.
12. How are ethers by williamsons's synthesis?
13. What are di and tri hydric phenols?
14. How is ether prepared in the laboratory?
15. Why phenol is more soluble in water than compounds?
16. What are crown ethers? Give an example.
17. What is SN_i reaction? Give an example.
18. Account for the bimolecular nature of SN_2 reaction.
19. Differentiate between E_1 and E_2 reactions.
20. Distinguish between cis and Trans eliminations.

PARAGRAPH QUESTIONS (5 MARK)

21. Compare Hoffmann and satzeff rule of elimination reaction with examples.
22. What are E_1 and E_2 reactions? Give examples.
23. Write the chemical properties of glycerol?
24. Mention the applications of crown ethers?
25. How is glycol and glycerol manufactured? Mention their important chemical properties.
26. What are crown ethers? Explain its application.
27. Explain the mechanism of aromatic nucleophilic substitution reactions.
28. Write detailed notes on nucleophilic substitution reaction of aryl halide and chlorobenzene.

29. How anisole is prepared industrially/in the laboratory? Specify the reagents and reaction conditions, if any.
30. How is phenol manufactured from coal tar?

Essay questions (10 marks)
31. How is phenol prepared? Explain its physical and chemical properties. Mention its uses?
32. Explain the mechanism involved in aromatic electrophilic substitution reaction with example.
33. Explain SN_1, SN_2 and SN_i reactions with suitable examples.
34. Discuss the effect of the reactions on a SN_2 reaction
      (i)   Leaving group
      (ii)   Nucleophile
      (iii)   Substrate
35. What is the action of allyl alcohol
     (i) bromine
     (ii) Conc.HNO_3
     (iii) Conc.H_2SO_4
     (iv) alk.$KMno_4$
     (v) HNO_2
36. Explain the formation of "Benzyne" intermediate from chlorobezene when treated with potassamide.
37. Explain the steric effect, polar effect, solvent effects on the course of SN_1 and SN_2 reactions.
38. Write notes on williamson's synthesis? Gatterman reaction and Houben-Hoesch reactions?
39. Any four substitution reactions of phenol with examples.
40. Describe the methods for the manufacture of phenols.

UNIT-IV
CHOOSE THE CORRECT ANSWERS

1. Which one of the following thermodynamic quantities is not a state function?
      a. Gibbs free energy
      b. enthalpy
      c. entropy
      d. work

2. All of the following have a standard heat of formation value of zero at 25°C and 1.0 atm except:
      a. $N_2(g)$
      b. Fe(s)

    c. H(g)
    d. Hg(l)

3. Which statement is in correct?
    a. The thermodynamic symbol for entropy is S.
    b. For an endothermic process, Δ H is negative.
    c. If the work done by the system is greater than the heat absorbed by the system, ΔE is negative.
    d. At constant pressure, ΔH=ΔE+PΔV

4. What will be the value of ΔH, if the forward and reverse reactions have the same energy of activation?
    a. ΔH =0
    b. ΔS =0
    c. ΔG =0
    d. ΔH = ΔG = ΔS =0

5. What will be the work done by 3moles of an ideal gas when it expands spontaneously in a vacuum?
    a. zero
    b. 9joules
    c. 3joules
    d. infinite

6. ΔH for the reaction $N_2+3H_2 \rightleftharpoons 2NH_3$
    a. ΔE+2RT
    b. ΔE −2RT
    c. ΔE −RT
    d. ΔH =RT

7. Which is true for the entropy of a spontaneous reaction?
    a. $\Delta S_{(system)} - \Delta S_{(surroundings)} > 0$
    b. $\Delta S_{(surroundings)} > 0$only
    c. $\Delta S_{(system)} + \Delta S_{(surroundings)} > 0$
    d. $\Delta S_{(system)} > 0$only

8. Which of the following is true?
    a. Q for reversible>Q for irreversible and work for reversible<work for irreversible
    b. Q for reversible<Q for irreversible and work for reversible> work for irreversible

c. Q for reversible<Q for irreversible and work for reversible<work for irreversible

d. Q for reversible>Q for irreversible and work for reversible>work for irreversible

9. In an open system, for maximum work, the process must be entirely
   a. irreversible
   b. reversible
   c. adiabatic
   d. none of the mentioned

10. Which of the following is true for a closed system?
    a. mass entering = mass leaving
    b. mass entering can be more or less than the mass leaving
    c. mass does not enter or leave the system
    d. none of the mentioned

Answers: 1 (d), 2 (c), 3 (b), 4. (a), 5 (a), 6 (b), 7(b), 8 (d), 9 (b), 10 (c)

SHORT QUESTIONS (2 MARK)

11. Define enthalpy.
12. What do you mean by isothermal and adiabetic process?
13. Differentiate between intensive and extensive variable.
14. Define intensive property, give an example.
15. What is extensive property with example?
16. Explain the terms of term internal changes.
17. Explain: open, closed and isolated system.
18. Define state function.
19. Why Cp is greater than Cv.
20. Define joule-thamson co-effecient.

PARAGRAPH QUESTIONS (5 MARK)

21. Derive the relationship between Cp and Cv.
22. Derive Kirchoff's equation.
23. Derive the relationship between the change in internal energy and change in enthalpy of an ideal system.
24. Derive the equationP1V1r=P2V2r
25. Prove that for a reversible, isothermal expansion of an ideal gas, ΔH=0.

26. Show PV_r=constant in the adiabetic expansion of an ideal gas.
27. Illustrate with an example; path function.
28. Write notes on exact differential- Give one example.
29. Explain state and path functions.
30. Show that for an ideal gas.

ESSAY QUESTIONS (10 MARK)
31. Derivetherateconstant"K"forsecondorderreactioniftheinitialconcentrationsof the reactions are same.
32. Define the following terms.
    (a) Internal energy(E)
    (b) Heat capacity
    (c) Isolated system
    (d) Open system
    (e) State of the system
33. Derive an expression for the relationship between pressure and volume of an ideal gas in an adiabetic process.
34. Deduce an expression for the change in internal energy and the change in temperature during the reversible adiabetic expansion of an ideal gas.
35. Describe the joule Thomson effect? Bring out its significance in the liquefaction of gases.
36. Explain Kirchoff's equation and its significance in temperature.
37. Show (with suitable example) how the heat of reaction rate of formation and resonance energy of a compound may be evaluated (can be calculated) from bond energy data.
38. Explain Hess'slaw and its important its thermodynamics
39. Derive relationship between the µJT and vander walls constant Ti.
40. Deduce an expression for the reversible isothermal process**.**

UNIT-V
CHOOSE THE CORRECT ANSWER

1. Which one of the following is a second order reaction?
    a. $CH_3COOCH_3+NaOH \rightarrow CH_3COONa+H_2O$
    b. $H_2 + Cl_2 \rightarrow 2HCl$
    c. $NH_4NO_3 \rightarrow N_2 +3H_2O$
    d. $H_2 + Br_2 \rightarrow 2BHr$

2. Consider the reaction, 2A+B→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. No unit
    b. mol $L^{-1}s^{-1}$
    c. s^{-1}
    d. L mol^{-1}s^{-1}

3. For the reaction:2A+B→3C+D
  Which of the following does not express the reaction rate?

    a. $\dfrac{-d[B]}{dt}$

    b. $\dfrac{d[B]}{dt}$

    c. $\dfrac{-d[A]}{dt}$

    d. $\dfrac{-d[C]}{3dt}$

4. Rate of a reaction can be expressed by Arrhenius equation
  as: $k = Ae^{-E/RT}$
   In this equation, E represents
    a. the total energy of the reacting molecules at a temperature,T.
    b. the energy below which colliding molecules will not react.
    c. The fraction of molecules with energy greater than the activation energy.
    d. The energy above which all the colliding molecules will react.

5. Which of these does not influence the rate of reaction?
    a. Nature of the reactants
    b. Concentration of the reactants
    c. Temperature of the reaction
    d. Molecularity of the reaction

6. When the concentration of reactant molecules is increased, the rate of reaction increases. The best explanation is: As the reactant concentration increases,

a. the average kinetic energy of molecules increases.
b. The frequency of molecular collisions increases.
c. the rate constant increases.
d. the activation energy increases.

7. A catalyst:
   a. actually participates in the reaction.
   b. Changes the equilibrium concentration of the products.
   c. Does not affect are action energy path.
   d. Always decreases the rate for are action.

8. The speed of a chemical reaction
   a. Is constant no matter what the temperature is.
   b. Is independent of the amount of contact surface of a solid involved.
   c. Between gases should in all cases be extremely rapid because the average kinetic energy of the molecules is great.
   d. between ions in aqueous solution is extremely rapid because there are no bonds that need to be broken.

9. The rate law of the reaction A+2B−>Product is given by d[Product]/dt=K[A]2.[B]. If A is taken in large excess, the order of the reaction will be
   a. 0
   b. 1
   c. 2
   d. 3

10. For the reaction A+B−>Products, it is found that the order of A is 2 and of B is 3 in the rate expression. When concentration of both is doubled the rate will increase by
    a. 10
    b. 6
    c. 32
    d. 16Answers

ANSWERS 1(a), 2 (d), 3(d), 4(b), 5(d), 6.(b), 7.(a), 8. (d), 9 (b), 10. (c)

SHORT QUESTIONS (2 MARK)

11. What is meant by the term rate law?
12. Give two examples of zero order reactions.
13. Give an example for zero, first and second order reactions.
14. What is meant by 'adsorption', how it is classified.
15. Define order of reactions.
16. What is activation energy?
17. Bring out the differences between the rate and rate constant so fare action.

18. Mention the order and molecularity of the following
reaction: 2A+B →Products
19. Give two examples for second order reactions?
20. What is the half-life period for the first order reactions?

PARAGRAPH QUESTIONS (5 MARK)
21. Distinguish between order and molecularity.
22. Explain the theory of absolute reaction rates.
23. Explain briefly the collision theory of reaction rates.
24. Explain homogeneous and heterogeneous catalysis with example.
25. Derive the rate constant for first order reaction.
26. Write short note on Freundlish adsorption isotherm
27. Explain the effect of temperature on the rate constant of a reaction.
28. Explain theory of unimolecular reactions.
29. Describe the derivation of third order reaction?
30. Explain any one theory for determine reaction rate.

ESSAY QUESTIONS (10MARK)
31. Compare collision theory and ARRT.
32. Explain various methods of determining the order of are action.
33. How is a reaction affected by a change of temperature? Write equation explaining this various factors/ terms in this equation.
34. Bring out the difference between unimolecular and pseudo unimolecular reaction.
35. The half-life period in a first order reaction is dependent of the initial concentration while it is not so in a second order reaction. Account for.
36. Derive the rate constant of a bimolecular reaction from collision theory.
37. Explain Arrehenius theory and its significance.
38. Write down the expression for the rate constants of a first and second order reaction.
39. Explain collision and Transition state theory.
40. Describe various factors affecting rate of a reactions.