



K21P 0971

Reg. No. :

Name :

III Semester M.Sc. Degree (CBSS – Reg./Suppl./Imp.)
Examination, October 2021
(2018 Admission Onwards)
CHEMISTRY

CHE3E.03 : Polymers and Material Chemistry

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **all** questions in **one** word or in **one** sentence. **Each** question carries **one** mark.

1. Write two examples for natural polymers.
2. Write down the structures of polypropylene and polystyrene.
3. Write an empirical equation connecting intrinsic viscosity with molecular size.
4. What is a homogeneous polymer ?
5. Name two high energy radiations which cause polymer degradation.
6. Mention the name of a polymer synthesised through solid phase polymerisation.
7. Name one of tantalum and mention its use.
8. What is porous bearing ? (8×1=8)

SECTION – B

Answer **any eight** questions. Answer may be in **two** or **three** sentences. **Each** question carries **two** marks.

9. What are thermoplastics ? Give two examples.
10. Write the rate equation for the free-radical chain polymerization and explain the terms.

P.T.O.



11. What is meant by living polymer ?
12. Mention Colligative properties that are used to measure the molecular mass of polymers.
13. How swelling occurs in a polymer ?
14. What is meant by fractionation of polymers ? Mention two methods used for the fractionation of polymers.
15. What is heterogeneous polymerization ? Mention two methods used for the heterogeneous polymerisation.
16. What is a Block Copolymer ? Schematically represent block copolymers.
17. What are biodegradable polymers ? Mention the name of a biodegradable polymer.
18. What are Die Steels ? Mention one of its use.
19. Write about four mechanical properties required for engineering materials.
20. What are the different optical properties to be considered for engineering materials ?
(8×2=16)

SECTION – C

Short paragraph questions. Answer **any four** questions. **Each** question carries **three** marks.

21. State and explain the organic and inorganic polymers. Give two examples for each.
22. Explain the mechanism of ring opening polymerization with a suitable example.
23. Briefly discuss the viscosity measurement for the determination of molecular size.
24. Explain the dissolution of polymer molecules in solution and schematically represent the 'micellar colloid' of soap molecule and 'molecular colloid' of polymer molecule.



25. What is suspension polymerisation ? Mention two monomers which can be used for solution polymerisation. Write about advantage and disadvantages of solution polymerisation.

26. What are refractory materials ? Explain the properties and applications of refractory materials with specific examples. (4×3=12)

SECTION – D

Essay type questions. Answer **four** questions. **Each** question carries **six** marks.

27. A) Define condensation polymerization and explain different types of condensation polymerization reactions with suitable examples.

OR

B) What is Ziegler-Natta Catalyst ? Explain the mechanism of Ziegler-Natta Catalysis.

28. A) Explain the use, principle and procedure of GPC.

OR

B) Explain vapour pressure lowering method to measure the molecular weight of polymer.

29. A) Explain the factors affecting thermal and mechanical, degradation of polymers.

OR

B) What is a graft copolymer ? Write two types of graft copolymerisation reactions with suitable examples.

30. A) Explain the following (a) Bearing (b) Hybrid composite and (c) Ceramic materials.

OR

B) Write short notes on (a) electrical properties and (b) magnetic properties of engineering materials. (4×6=24)



K20P 1082

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Examination, October 2020
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CHEMISTRY**

CHE 3E.03 : Polymers and Material Chemistry

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **all** questions. **Each** question carries **one** mark :

1. How does cellobiose differ from maltose ?
2. What are the starting materials for Bakelite ?
3. Polydispersity index of a polymer is unity. What does it mean ?
4. Name any material which is used as the gel in gel permeation chromatography.
5. Show a curing reaction of any one polymer.
6. Why PVC is highly susceptible to thermal degradation ?
7. Give an example of a hybrid composite.
8. Give the composition of a copper base casting alloy. (8×1=8)

SECTION – B

Answer **any eight** questions. Answer may be in **two** or **three** sentences. **Each** question carries **two** marks :

9. Give an example of ring opening polymerization.
10. What is glass transition temperature of polymers ?

P.T.O.



11. What is the basic structural difference between starch and cellulose ?
12. Differentiate between weight average molecular weight and number average molecular weight.
13. What is the driving force for polymer solubility ?
14. Name the factors which affect the swelling of polymers.
15. What are polymer blends ? Give examples.
16. Give an example for hydrolytic degradation of polymer.
17. Give two specific examples for the reaction of functional groups on polymeric chains.
18. Comment about optical property of any specific engineering material.
19. Classify ceramic materials.
20. Distinguish between ferromagnetism and paramagnetism. (8x2=16)

SECTION – C

Answer **any four** questions, **each** in a paragraph. **Each** question carries **3** marks :

21. How various intermolecular forces affect the physical properties of polymers ?
22. Illustrate how Ziegler Natta catalyst can be employed to synthesize an isotactic polymer.
23. Discuss the relevance of measurement of viscosity of polymer solution.
24. Explain briefly the principle and process of ultracentrifugation of a polymeric product.
25. Briefly explain two vulcanization methods used in rubber industry.
26. Discuss the bulk polymerization process and list the advantages and drawbacks.
27. Write a short note on the bearing materials.
28. Demonstrate the importance of refractories, taking the example of tungsten based materials. (4x3=12)



SECTION - D

K20P 1082

Answer either **A** or **B** of each question. Each question carries **6** marks :

29. A) Explain briefly the mechanism and kinetics of radical chain polymerization.

OR

B) Enumerate and discuss the mechanical properties exhibited by crystalline polymers.

30. A) Discuss the Flory Huggins theory of polymer solution.

OR

B) How the measurement of colligative properties can be utilized to calculate the average molecular weight of polymers ?

31. A) Discuss various methods of degradation of polymers.

OR

B) Discuss the importance of various types of post-synthetic modification of polymers.

32. A) List and elaborate various die-casting alloys used in the tool and die industry.

OR

B) Write a note on the properties and applications of various classes of composite materials.

(4×6=24)



K18P 0890

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Third Semester M.Sc. Degree (Reg./Suppl./Imp.) Examination, October 2018
CHEMISTRY

(2014 Admn. Onwards)

CHE 3E.03 : Polymers and Material Chemistry

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **all** questions in **one** word or **one** sentence. **Each** question carries **one** mark.


1. Calculate the degree of polymerization of a mono-disperse PVC, if its molecular weight is 53,550 Da (molecular mass of vinyl chloride is 63 g mol^{-1}).
2. Mention the basic structural difference between starch and cellulose.
3. Write any one method to find out weight average molecular weight of a polymer.
4. What is end group analysis ?
5. What is a polymer blend ?
6. The final product of emulsion polymerization is latex. Which of the following process can be used to isolate the polymer from this latex ?
a) Evaporation b) Non-solvents c) Coagulation d) Crystallisation
7. Give one examples each for ferromagnetic and paramagnetic material.
8. Name one ore of tantalum from which it is extracted.

SECTION – B

Answer **any eight** questions. Answer may be in **two** or **three** sentences. **Each** question carries **two** marks.

9. Isotactic polypropylene (PP) films are less permeable to gas as compared to atactic polypropylene. Why ?
10. What is gel point in step-reaction polymerization ? How it is experimentally identified ?

P.T.O.

- 
11. Cold cracked rubber does not contract easily. Comment on this.
 12. The solubility parameter value (δ) for solvents n-octanol ($\delta = 10.3$), n-butanol ($\delta = 11.4$) and methanol ($\delta = 14.5$) show an increasing trend. Why?
 13. Why is the osmometric method for molecular weight determination preferred over viscosity and GPC methods?
 14. Small amount of divinylbenzene (DVB) is added in the polymerization of styrene for use as an ion exchange resin. Why?
 15. Cite one example each for photo and bio-degradation of polymers.
 16. How is vulcanization of rubber carried out?
 17. Block and graft copolymers are very good stabilizers for colloidal dispersions. Substantiate.
 18. Explain why alloys formed from two or more different metals often have superior properties compared to the pure metals.
 19. What is a porous bearing?
 20. Metals such as gold, silver and aluminium are good conductors of electricity, but titanium and mercury are not. Explain.

SECTION - C

Short paragraph questions. Answer **any four** questions. **Each** question carries 3 marks.

21. Exemplify the concept of ring opening polymerization.
22. Briefly illustrate the mechanism of coordination polymerization using Ziegler Natta catalyst.
23. Describe any one method for measuring the weight-average molecular weights of polymers.
24. Depict, how cryoscopy helps in determining the molecular weight of a polymer?



25. Exemplify gas phase polymerization reactions.
26. Define and describe micelles and discuss their role in emulsion polymerization.
27. Write a brief note on novel materials which find applications due to its unique optical properties.
28. Illustrate the sol-gel process for the synthesis of ceramics.

SECTION – D

Essay type questions. Answer **four** questions. **Each** question carries **6** marks.

29. A) Discuss the mechanism and kinetics of step reaction polymerization.

OR

- B) Elaborate various parameters associated with physical properties of polymers and factors affecting them.

30. A) Portray the principle and experimental set up of GPC technique for the fractionation and molecular weight determination of polymers.

OR

- B) Explain the Flory Huggins theory of polymer solution.

31. A) Give a note on various types of degradation of polymers.

OR

- B) Enumerate various reaction strategies for the preparation of graft and block polymers.

32. A) Illustrate the various magnetic properties associated with materials.

OR

- B) List and explain the preparation and properties of various metal alloys for the manufacture of tool materials.
-



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CHEMISTRY
(2014 Admn. Onwards)
CHE 3E.03 : Polymers and Material Chemistry

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **all** questions in **one** word or **one** sentence. **Each** question carries **one** mark.

1. Calculate the degree of polymerization of a mono-disperse PVC, if its molecular weight is 53,550 Da (molecular mass of vinyl chloride is 63 gmol^{-1}).
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4. What is end group analysis ?
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6. The final product of emulsion polymerization is latex. Which of the following process can be used to isolate the polymer from this latex ?
a) Evaporation b) Non-solvents c) Coagulation d) Crystallisation
7. Give one examples each for ferromagnetic and paramagnetic material.
8. Name one ore of tantalum from which it is extracted.

SECTION – B

Answer **any eight** questions. Answer may be in **two** or **three** sentences. **Each** question carries **two** marks.

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10. What is gel point in step-reaction polymerization ? How it is experimentally identified ?

P.T.O.

K18P 0890

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11. Cold cracked rubber does not contract easily. Comment on this.
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13. Why is the osmometric method for molecular weight determination preferred over viscosity and GPC methods?
14. Small amount of divinylbenzene (DVB) is added in the polymerization of styrene for use as an ion exchange resin. Why?
15. Cite one example each for photo and bio-degradation of polymers.
16. How is vulcanization of rubber carried out?
17. Block and graft copolymers are very good stabilizers for colloidal dispersions. Substantiate.
18. Explain why alloys formed from two or more different metals often have superior properties compared to the pure metals.
19. What is a porous bearing?
20. Metals such as gold, silver and aluminium are good conductors of electricity, but titanium and mercury are not. Explain.

SECTION - C

Short paragraph questions. Answer **any four** questions. **Each** question carries 3 marks.

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22. Briefly illustrate the mechanism of coordination polymerization using Ziegler Natta catalyst.
23. Describe any one method for measuring the weight-average molecular weights of polymers.
24. Depict, how cryoscopy helps in determining the molecular weight of a polymer?



25. Exemplify gas phase polymerization reactions.
26. Define and describe micelles and discuss their role in emulsion polymerization.
27. Write a brief note on novel materials which find applications due to its unique optical properties.
28. Illustrate the sol-gel process for the synthesis of ceramics.

SECTION - D

Essay type questions. Answer **four** questions. **Each** question carries **6** marks.

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OR

- B) Elaborate various parameters associated with physical properties of polymers and factors affecting them.

30. A) Portray the principle and experimental set up of GPC technique for the fractionation and molecular weight determination of polymers.

OR

- B) Explain the Flory Huggins theory of polymer solution.

31. A) Give a note on various types of degradation of polymers.

OR

- B) Enumerate various reaction strategies for the preparation of graft and block polymers.

32. A) Illustrate the various magnetic properties associated with materials.

OR

- B) List and explain the preparation and properties of various metal alloys for the manufacture of tool materials.
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K21P 0970

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III Semester M.Sc. Degree (CBSS – Reg./Suppl./Imp.)
Examination, October 2021
(2018 Admission Onwards)
CHEMISTRY
CHE 3C.10 : Physical Chemistry – III

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **all** questions in **a** word or sentence. **Each** question carries **1** mark. **(8×1=8)**

1. What is transmission coefficient ?
2. Distinguish between collision complex and activated complex.
3. State steady state approximation.
4. Distinguish between prototropic and protolytic mechanism of acid base catalysis.
5. Explain the term KLM with reference to Auger electron spectroscopy.
6. Distinguish between associative and dissociative type of chemisorption.
7. What do you mean by electro kinetic phenomena ?
8. What is streaming potential ?

SECTION – B

Answer **eight** questions. Answers may be in **one** or **two** sentences. **Each** question carries **2** marks. **(8×2=16)**

9. For the reactions $A \xrightarrow{k_1} B$, $A \xrightarrow{k_2} C$ find concentrations of A, B and C as function of time.
10. What is the effect of pressure on the rate of gas phase reactions ?
11. How would you follow a fast reaction by NMR spectroscopy ?

P.T.O.

12. Account for the high quantum yield of $H_2 - Cl_2$ reaction.
13. Distinguish between general and specific H^+ ion catalysis.
14. What is secondary salt effect ?
15. Write Gibbs adsorption isotherm. How is it verified ?
16. Define isosteric heat of adsorption. How is it measured ?
17. Unimolecular gas phase surface catalysed reactions follow first order kinetics at low pressures and zero order kinetics at high pressures. Why ?
18. State and explain Schultz-Hardy rule.
19. Define zeta potential. Explain its significance.
20. What is isoelectric pH ? Explain its significance.

SECTION - C

Answer **four** questions. **Each** question carries **3** marks.

(4×3=12)

21. With the help of potential energy surface explain reaction coordinate.
22. The pre exponential factor for a first order reaction is $2 \times 10^{13} s^{-1}$. Calculate entropy of activation at 500 K.
23. Briefly explain flow method of studying fast reactions.
24. Taking one example discuss Rice-Herzfeld mechanism of organic decomposition reaction.
25. Derive Brønsted Bjerrum equation.
26. Discuss Eley Redial mechanism of surface catalysed reactions.
27. 160 ml of N_2 (corrected to STP) was required to form a monolayer on 1_g of a solid. Find the surface area of the solid. The cross sectional area of N_2 is 16.2 \AA^2 .
28. Briefly discuss electrophoresis.



SECTION - D

Answer either 'a' or 'b' of each question. Each question carries 6 marks. (4×6=24)

29. a) Briefly discuss Collision theory of reaction rates.

OR

b) Discuss briefly.

- i) Relaxation method.
- ii) Flash photolysis.

30. a) Briefly discuss Somenoff-Hinshelwood theory of branching chain reactions.

OR

b) Write mechanism for the photochemical reaction between H_2 and Br_2 . Derive the rate law.

31. a) Derive BET adsorption isotherm.

OR

b) Discuss theory and applications of ESCA.

32. a) Write a briefly account of the methods for determination of molar mass of polymers.

OR

b) Discuss Donnan Membrane equilibrium. What are its applications ?



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Examination, October 2020

(2014 Admission Onwards)

CHEMISTRY

CHE 3C.10 : Physical Chemistry – III

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **all** questions in **a word** or **sentence**. Each question carries **1** mark. **(8×1=8)**

1. Explain the term 'threshold energy' in collision theory of reaction rates.
2. Define relaxation time.
3. Distinguish between Arrhenius complex and van't Hoff Complex.
4. What is primary salt effect?
5. What is surface pressure?
6. Explain term KLL with reference to Auger electron Spectroscopy.
7. State Hardy-Schultz rule.
8. Define isoelectric pH.

SECTION – B

Answer **eight** questions. Answers may be in **one** or **two** sentences. Each question carries **2** marks. **(8×2=16)**

9. Decomposition of NO_2Cl follows the mechanism



Derive the rate law.

P.T.O.

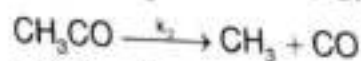
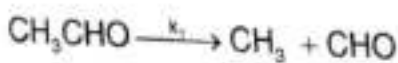
10. Define enthalpy of activation. How is it related to activation energy for
 a) first order reaction
 b) second order gas phase reaction?
11. How would you follow fast reactions by NMR spectroscopy?
12. What is secondary salt effect?
13. What is 'cage effect'?
14. Write Taft equation. Explain.
15. What is the application of LEED in surface analysis?
16. Spontaneous adsorption is always exothermic. Why?
17. Distinguish between activated and nonactivated adsorption.
18. What is stern model of electrical double layer?
19. Explain with example micelle.
20. What is sedimentation potential?

SECTION - C

Answer **four** questions. **Each** question carries **3** marks.

(4x3=12)

21. Show that for the rigid sphere model of bimolecular reactions Absolute Rate Theory agrees with simple Collision Theory.
22. Discuss relaxation method of studying fast reactions.
23. Decomposition of acetaldehyde follows the mechanism given below. Derive the rate law.



24. Briefly discuss Michaelis-Menten theory of enzyme catalysis.

25. Derive Gibbs adsorption isotherm.
26. Write BET adsorption isotherm. Show that it approximates to Langmuir adsorption isotherm under limiting conditions. What is the limiting condition ?
27. Briefly explain Donnan Membrane equilibrium.
28. Derive an equation to show the relationship between diffusion coefficient and molecular size.

SECTION - D

Answer either 'a' or 'b' of each question. **Each** question carries **6** marks. (4×6=24)

29. a) Discuss Absolute Rate Theory of reaction rates.

OR

- b) What are the drawbacks of Lindemann's theory of unimolecular reactions ? How is it modified ? Discuss.

30. a) Write mechanism for photochemical reaction between H_2 and Cl_2 . Derive the rate law.

OR

- b) i) Compare kinetics of reactions in solution with the kinetics of gas phase reactions.
ii) Derive an equation to show the effect of dielectric constant of the medium on the rate of ionic reactions.

31. a) What are the methods of determining surface area of solids ? Discuss.

OR

- b) i) Show that for competitive adsorption of two gases A and B, the fractional surface coverage θ_A for adsorption of gas A is given by

$$\theta_A = \frac{b_A P_A}{1 + b_A P_A + b_B P_B}$$

(P_A and P_B are partial pressures of A and B b_A and b_B are constants)

- ii) Discuss theory and applications of XPS.

32. a) Discuss briefly stability of Colloids.

OR

- b) Derive an equation for zeta potential from electro osmotic measurements.

K18P 0889



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CHEMISTRY
(2014 Admn. Onwards)
CHE3C.10 : Physical Chemistry – III

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **all** questions (**Each** in one word or sentence). **Each** question carries **1** mark.

1. State principle of microscopic reversibility.
2. What is collision cross section ?
3. What is Taft equation ?
4. Distinguish between prototropic and protolytic mechanism.
5. What is surface pressure ?
6. Distinguish between associative and dissociative type of chemisorption.
7. Lyophilic colloids are generally stable. Why ?
8. Suggest one method of determining number average molecular weight.

SECTION – B

Answer **eight** questions. Answer may be in one or two sentences.
Each question carries **2** marks.

9. Define steric factor. How is it related to entropy of activation ?
10. Explain the term potential energy surface.
11. Define enthalpy of activation. How is it related to energy of activation ?
12. Account for the explosion limits in $H_2 - O_2$ reaction.
13. Distinguish between diffusion controlled and activation controlled reactions.

P.T.O.

K18P 0889

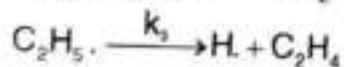
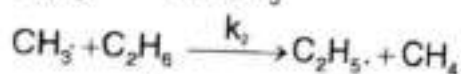
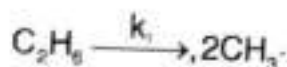
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14. Distinguish between Vant – Hoff complex and Arrhenius complex.
15. Define micelle. How is it formed ?
16. What do you mean by ESCA ? Name two ESCA techniques.
17. Enthalpy of adsorption is a function of surface coverage. Justify the statement.
18. Explain osmotic pressure method of molecular weight determination.
19. What are the models of electrical double layer ? Explain.
20. What is Donnan Membrane equilibrium ?

SECTION – C

Answer **four** questions. **Each** question carries **3** marks.

21. For the reaction $A + B \xrightleftharpoons[k_{-1}]{k_1} C$, derive equations for k_1 and k_{-1} .
22. Briefly discuss Lindmann's theory of unimolecular reactions.
23. Decomposition of ethane takes place by the following mechanism. Derive the rate law



(\cdot represents radical)

24. Briefly explain Langmuir – Film balance experiment.
25. One gram of a solid required 130 ml of N_2 (corrected to $0^\circ C$ and 1 atm. pressure) to form a monolayer. Calculate the surface area of the solid. Cross sectional area of N_2 is 16.2 \AA^2 .
26. What are the factors affecting stability of colloids ? Discuss.
27. For the dissociative chemisorption $A_{2(g)} \xrightleftharpoons[k_{-1}]{k_1} 2A \text{ ads.}$ derive an equation for the fractional surface coverage θ using Langmuir theory.
28. Define isosteric heat of adsorption. How is it measured ? Explain.

SECTION - D

Answer either **A** or **B** of each question. Each question carries **6** marks.

29. A) Briefly discuss relaxation method of studying fast reactions.

OR

B) What are the assumptions in simple collision theory? Derive an equation for bimolecular rate constant using the theory.

30. A) Write mechanism for photochemical reaction between H_2 and Br_2 . Derive the rate law.

OR

B) Derive Bronsted Bjerrum equation. Discuss.

31. A) Briefly discuss Rideal mechanism for bimolecular surface catalysed reactions.

OR

B) Write a brief account of the methods for the determination of surface area of solids.

32. A) Briefly discuss light scattering method of determining molecular weight of macromolecules.

OR

B) Define zeta potential. How is it evaluated? Discuss.

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Examination, November 2017
CHEMISTRY
CHE3C.10 : Physical Chemistry – III
(2014 Admn. Onwards)

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **all** questions, **each** in **one** word or **one** sentences. **Each** question carries 1 mark.

1. Unimolecular gas phase reactions follow first order kinetics at high pressures and second order kinetics at low pressures. Justify the statement.
2. For the reaction $A \xrightarrow{k_1} B \xrightarrow{k_2} C$, find steady state concentration of B.
3. Define Michaelis-Menten constant.
4. Write Hammett equation. Explain the terms.
5. Define isosteric heat of adsorption.
6. Distinguish between activated and nonactivated adsorption.
7. Define zeta potential.
8. Suggest one method each to determine a) Number average b) Weight average molar mass of macromolecules.

SECTION – B

Answer **eight** questions. Answer may be in **one** or **two** sentences. **Each** question carries **2** marks.

9. How would you determine entropy of activation ?



10. Define :
 - a) Steric factor
 - b) Threshold energy with reference to collision theory.
11. Define volume of activation. How is it determined ?
12. Distinguish between general acid and specific H^+ catalysis.
13. What is secondary salt effect ?
14. What is branching chain reaction ? Write one example.
15. Write Gibbs adsorption isotherm. How is it verified ?
16. Calculate the wavelength of electrons accelerated by a potential of 1000 V.
17. What are the assumptions of Langmuir adsorption isotherms ?
18. What is stern model of electrical double layer represent graphically ?
19. State and explain Schultz Hardy rule.
20. Define electrokinetic phenomena. List the various electrokinetic phenomena.

SECTION - C

Answer **four** questions. **Each** question carries **3** marks.

21. For two parallel reactions $A \xrightarrow{k_1} B$ and $A \xrightarrow{k_2} C$ derive equations for the concentration of A, B and C on a function of time. Represent graphically.
22. Show that for the rigid sphere model of bimolecular reaction show that absolute rate theory agrees with simple collision theory.
23. Write rice Herzfeld mechanism for the decomposition of acetaldehyde. Derive the rate law.
24. Derive an equation for the influence of dielectric constant of the medium on the rate of ionic reactions in solution.
25. For competitive adsorption of two gases A and B show that the fractional surface coverage $Q_A = \frac{b_A P_A}{1 + b_A P_A + b_B P_B}$ P_A and P_B are the partial pressures of gases A and B, b_A and b_B are the equilibrium constants for the adsorption of A and B.



26. What is Donnan Membrane equilibrium? Discuss its applications.
27. Briefly discuss Langmuir film balance experiment.
28. What are the factors affecting stability of colloids? Discuss.

SECTION - D

Answer either **A** or **B** of each question. Each question carries 6 marks.

29. A) What are the assumptions in Transition State Theory? Derive an equation for the rate constant of a bimolecular reaction using transition state theory.

OR

B) Write a brief account of the methods of studying fast reactions.

30. A) Discuss briefly Somenoff Herishelwood theory of branching chain reactions.

OR

B) What are the mechanisms of acid base catalysis? Discuss.

31. A) Derive BET adsorption isotherm.

OR

B) Write a brief account of the methods for the determination of surface area of solids.

32. A) Derive an equation for zeta potential from electrophoresis.

OR

B) Discuss light scattering method of determining weight average molecular weight.



K20P 1079

Reg. No. :

Name :

III Semester M.Sc. Degree (CBSS – Reg./Suppl./Imp.)
Examination, October 2020
(2014 Admission Onwards)
CHEMISTRY
CHE 3C.08 : Inorganic Chemistry – II

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **all** questions in **one** word or **one** sentence. **Each** question carries **one** mark.

1. Give one example for a metal complex with coordination number 5.
2. The structure of $K_2[Ni(CN)_4]$ is _____
3. The term symbol for Mn^{3+} is _____
4. Name two calibrants used in Gouy balance.
5. When an yellow complex $[Ni(en)_2]Br_2$ is dissolved in pyridine a blue solution is formed; why ?
6. Why chelate effect is considered as an entropy effect ?
7. What are 'naked clusters' ?
8. Give one example for transmetallation reaction. (8×1=8)

SECTION – B

Answer **any eight** questions. Answer may be in **two** or **three** sentences. **Each** question carries **two** marks.

9. Do you find any difference in the geometries of $[Mn(H_2O)_6]^{2+}$ and $[Mn(H_2O)_6]^{3+}$?
Substantiate your answer.

P.T.O.



10. What is meant by nephelauxetic series ? Explain.
11. Calculate the LFSE for an octahedral cobalt (II) complex for which $\Delta_0 = 275 \text{ kJmol}^{-1}$ and the electron pairing energy $P = 250 \text{ kJmol}^{-1}$.
12. What is meant by spin crossover ? Explain with an example.
13. Calculate the number of microstates for d^4 configuration.
14. Account for the intense yellow colour of ceric ammonium sulphate solution.
15. State and explain Irving-William order of stability.
16. The rate of substitution reaction of $\text{Cr}(\text{CO})_6$ is very low, consistent with a low spin d^6 complex; but the isoelectronic complex $[\text{V}(\text{CO})_6\text{NO}]$ is very reactive, why ?
17. Differentiate between electron exchange and electron transfer reactions.
18. What is meant by oxidative carbonylation reaction ? Explain with an example.
19. What hapticities are possible for 1,3-butadiene ? Sketch the interactions.
20. Give any two synthetic applications of Grignard's reagent. (8×2=16)

SECTION – C

Short paragraph questions. Answer **any four** questions. **Each** question carries **three** marks.

21. Comment on the spectral consequences of Jahn-Teller distortion in copper (II) complexes.
22. Ionic radii of M^{2+} ions are expected to decrease smoothly from Sc^{2+} to Zn^{2+} . But the change is not regular. Why ?
23. Assign the electronic transition in $[\text{V}(\text{H}_2\text{O})_6]^{3+}$ with the help of Orgel diagram.
24. What is meant by spin-orbit coupling ? Explain.
25. Write a note on photochemical reactions of transition metal complexes.
26. Derive the relationship between stepwise and overall formation constants of a metal complex.

27. Give an account of the synthesis and structure of Zeise's salt.
28. Discuss the factors that favour the formation of metal clusters.

(4×3=12)

SECTION - D

Essay type questions. Answer **four** questions. **Each** question carries **six** marks.

29. A) What are the important assumptions of V.B. theory? How this theory is useful in the structural study of transition metal complexes? What are its limitations?

OR

- B) Sketch the MO diagram for cobalt (II) low-spin octahedral complex with σ -bonding only and discuss its salient features. What is the effect of π -bonding on the stability of metal complexes?

30. A) Describe the Gouy method for determining the magnetic moment value of solid metal complexes. Bring out the significance of Pascal's constant in this study.

OR

- B) Calculate $10 Dq$ and β value for the complex species $[\text{Ni}(\text{MeNH}_2)_6]^{2+}$ from the following spectral data.

$\nu_1 = 10,000 \text{ cm}^{-1}$, $\nu_2 = 16,780 \text{ cm}^{-1}$, $\nu_3 = 27,320 \text{ cm}^{-1}$ and $\beta = 1030 \text{ cm}^{-1}$ for free Ni^{2+} ion.

31. A) Discuss the A, D and I mechanisms of substitution reactions in octahedral metal complexes.

OR

- B) What is trans effect? Discuss the synthetic applications of trans effect with suitable examples.

32. A) Draw the catalytic cycle and discuss the reactions and mechanisms involved in Monsanto acetic acid process.

OR

- B) How is ferrocene synthesised? Give an account of its reactions and structure.

(4×6=24)

K17P 1300

Reg. No. :

Name :

Third Semester M.Sc. Degree (Reg./Suppl./Imp.) Examination, November 2017
CHEMISTRY

CHE 3C.08 : Inorganic Chemistry – II
(2014 Admn. Onwards)

Max. Marks : 60

Time : 3 Hours

SECTION – A

Answer **all** questions in **one** word or **one** sentence. **Each** question carries **1** mark.

1. Calculate the spin-only magnetic moment value for $[\text{FeF}_6]^{3-}$ and $[\text{Fe}(\text{CN})_6]^{3-}$.
2. What do you mean by CFSE ?
3. Derive the ground state term symbol for Fe^{2+} and Cr^{3+} .
4. Find out the CFSE for a d^6 octahedral complex having $\Delta_0 = 25000 \text{ cm}^{-1}$ and pairing energy $P = 15000 \text{ cm}^{-1}$.
5. Chelate effect is considered as an entropy effect. Why ?
6. What do you mean by Irving-William stability order ?
7. What is metathesis reaction ?
8. Calculate the number of metal-metal bonds in $\text{Co}_4(\text{CO})_{12}$. (8×1=8)

SECTION – B

Answer **any eight** questions. Answer in **two** or **three** sentences. **Each** question carries **2** marks.

9. What are the limitations of valence bond theory ?

P.T.O.

10. Tetrahedral complexes are always of high-spin. Why?
11. The structure of $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ is octahedral whereas $[\text{Mn}(\text{H}_2\text{O})_6]^{3+}$ is a tetragonally distorted octahedral structure. Why?
12. A solution of MnSO_4 is feebly coloured or almost colourless while that of KMnO_4 is intensely coloured. Give reasons.
13. What is meant by spin crossover? Explain with an example.
14. For $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$, the absorption maximum due to d-d transition was found at $20,000 \text{ cm}^{-1}$. Calculate its LFSE.
15. Differentiate between kinetic stability and thermodynamic stability of metal complexes.
16. Explain isomerisation reactions of metal complexes with an example.
17. Give two examples for photochemical reactions of transition metal complexes.
18. Discuss the structure of LiCH_3 .
19. What is transmetallation reaction? How this reaction is useful for the preparation of organometallic compounds?
20. Account for the change in olefinic bond length on forming Zeise's salt.

(8×2=16)

SECTION - C

Short paragraph questions. Answer **any four** questions. **Each** question carries **3** marks.

21. Sketch the geometries for metal complexes with co-ordination numbers 4, 5 and 7. Give one example for each.
22. Draw the d orbital splitting diagrams for tetrahedral and square planar ligand fields. Give reasons for such type of splitting pattern.

23. Construct the Orgel diagram for $[V(H_2O)_6]^{3+}$ and assign the possible electronic transitions.
24. Differentiate between ferromagnetism and antiferromagnetism. How do they vary with temperature?
25. Write a note on base hydrolysis.
26. Discuss the pH metric method for determining the stability of a metal complex.
27. What do you mean by hapticity of organic ligands? What hapticities are possible for the following compounds?
 a) 1,3-butadiene
 b) Dibenzene chromium
 Sketch the interactions.
28. Explain the migratory insertion reactions of organometallic compounds with an example. (4×3=12)

SECTION - D

Essay type questions. Answer **any four** questions. **Each** question carries **6** marks.

29. a) Sketch the molecular orbital diagrams for octahedral nickel(II) complex with σ -bonding only and discuss its salient features. What is the effect of π -bonding on the stability of metal complexes?

OR

- b) Compare and contrast the VB theory and CF theory of co-ordination compounds.
30. a) Describe the Gouy method for the determination of magnetic moment value of a solid metal complex. Discuss the importance of Pascal's constant in this study.

OR

- b) How do orbital contribution and spin orbit coupling affect the spin-only magnetic moment value? Discuss the application of magnetic moment measurement in the structural investigation of nickel(II) complexes.

31. a) Discuss the mechanism and rate law expression for substitution reactions of octahedral transition metal complexes.

OR

- b) Describe the factors that favour the formation of metal complexes. Outline the spectroscopic method for determining the stability of metal complexes.
32. a) What are the factors that favour the formation of metal-metal bonds in metal clusters? Discuss the structure and bonding in $[\text{Re}_2\text{Cl}_8]^{2-}$.

OR

- b) Draw the catalytic cycle and discuss the reactions and mechanism involved in Monsanto acetic acid process.

(4×6=24)

K21P 0969

Reg. No. :

Name :

III Semester M.Sc. Degree (CBSS – Reg./Suppl./Imp.)

Examination, October 2021

(2018 Admission Onwards)

CHEMISTRY

CHE3C.09 : Organic Chemistry – III

Time : 3 Hours

Max. Marks : 60

SECTION – A

(Answer **all** questions in **one** word or **one** sentence. **Each** question carries **one** mark.)

1. Out of cis- and trans- isomer of cinnamic acid which isomer absorbs at higher wavelength ?
2. In an organic compound, there is no absorption in the region of 1600 cm^{-1} , 1580 cm^{-1} and 1500 cm^{-1} . This gives a sure proof absence of which functional group ?
3. Write the multiplicity of signals of $\text{CH}_3 - \text{CH}_2 - \text{NH}_2$ in ^1H NMR spectroscopy.
4. How will you account triplet splitting pattern of CDCl_3 at δ 76, 77, 78 ppm in ^{13}C NMR ?
5. Write the source of the electrons, which required for the bombardment in EI Mass spectrometry .
6. What do you mean by Nitrogen rule ?
7. By which name reaction oxetanes can be prepared ?
8. Write the structure of 1,2,4-triazine. (8×1=8)

SECTION – B

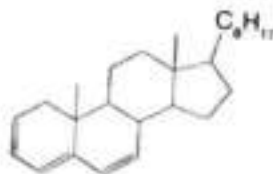
(Answer **any eight** questions. Answer may be in **two** or **three** sentences. **Each** question carries **2** marks.)

9. How will you account the difference in the value of λ_{max} in the following two compounds ? Discuss in detail.
a) $\text{CH}_3\text{Cl} - 173\text{ nm}$ b) $\text{CH}_3\text{I} - 258\text{ nm}$.

P.T.O.



10. If we add 20 ml of CCl_4 to 4 ml of ethyl alcohol how the position of O-H stretching frequency of ethyl alcohol is varied from the pure state? Give a suitable explanation.
11. Calculate the λ_{max} of following compound by applying Woodward Fieser rule.



12. On oxidation 2-propanol will be converted to propanone. How can you monitor the progress of this reaction by IR spectroscopy?
13. $\text{P-O MeC}_6\text{H}_4\text{-Me}$ shows in its ^1H NMR spectrum two peaks at δ (ppm) 2.34 and 3.75. Assign these two signals and comment about the signal positions.
14. What is the order of chemical shift of protons attached to tertiary, secondary, primary carbons? Explain why.
15. How can you distinguish ethyl benzene from m-xylene by ^{13}C NMR spectroscopy?
16. The proton decoupled ^{13}C NMR spectrum of $\text{C}_6\text{H}_3\text{Br}_3$ gives only two signals. Write the suitable structure of the compound and explain why spectrum follows this pattern.
17. How will you differentiate 3-methylcyclohexene from 4-methylcyclohexene by mass spectrometry?
18. What is the importance of meta stable peaks? Illustrate with example.
19. Discuss a method for the synthesis of 1,2,4-triazole with reaction.
20. Explain the method of synthesis of coumarin.

(8×2=16)

SECTION – C

(Short paragraph questions. Answer **any four** questions. **Each** question carries 3 marks.)

21. What are batho, hypso, hypo and hyper chromic shift of absorption bands in UV-V is spectroscopy? Illustrate with examples.

- How conjugation affect the stretching frequency of carbonyl compounds ? Explain with different examples.
23. Explain the usage of shift reagents in the simplification of NMR spectra.
24. Discuss the working principle of FAB mass spectrometry.
25. A compound with molecular formula C_7H_8O shows peaks at δ (ppm) 9.8, s, 1H and 7.2, m, 5H. It is on reaction with hydroxylamine followed by P_2O_5 resulted another compound with molecular formula C_7H_8N which showed an IR peak 2210 cm^{-1} and a 1H NMR signal at δ (ppm) 7.3, s, 5H. Deduce the structure of these two compounds writing the reaction scheme.
26. Which is the preferred position of electrophilic substitution reaction in imidazoles and why ? Write examples for important electrophilic substitution reactions in imidazoles. (4×3=12)

SECTION - D

(Essay type questions. Answer **four** questions. **Each** question carries **6** marks.)

27. A) Explain Woodward-Fieser rules in predicting the λ_{max} of dienes, α , β -unsaturated carbonyl compounds and arenes with examples.

OR

- B) Discuss the concept of group frequencies in IR spectroscopy for structural elucidation illustrating with different classes of organic compounds.

28. A) Discuss :

- i) Simplification of complex spectra by using high field NMR
- ii) DEPT spectroscopy
- iii) CIDNP.

OR

- B) Discuss :

- i) Simplification of complex spectra by use of double resonance method
- ii) FT NMR spectroscopy
- iii) Theory of spin-spin splitting citing suitable example.



29. A) Deduce the structure and stereochemistry of the compound from the following spectral data. Explain the pattern of each and every signals with suitable explanation.

- i) UV - 284 nm, 308 nm
- ii) IR - 1690 cm^{-1}
- iii) $^1\text{H NMR}$ - δ (ppm) - 6.7 (dd, $J=16\text{ Hz}, 8\text{ Hz}, 1\text{H}$), 7.40 (m, 5H), 7.45 (d, $J=16\text{ Hz}, 1\text{H}$), 9.75 (d, $J=8\text{ Hz}, 1\text{H}$)
- iv) $^{13}\text{C NMR}$ - δ (ppm) - 128.2, 128.3, 128.8, 131.0, 134.0, 152.0, 193.0.
- v) Mass - m/z - 132, 131, 103

OR

B) a) Deduce the structure of the compound from the following spectral data. Explain the pattern of each and every signals with suitable explanation.

- i) Molecular Formula- $\text{C}_{10}\text{H}_{12}\text{O}_2$
 - ii) IR- $1730, 3000\text{ cm}^{-1}$
 - iii) $^1\text{H NMR}$ - δ (ppm) - 6.8 -7.3 (m, 5H), 4.3 (t, 2H), 2.93 (t, 2H), 2.0 (s, 3H)
 - iv) Mass - m/z - 73, 91, 149, 164
- b) Fragmentation pattern in carbonyl compounds.

30. A) Discuss the structure, synthesis and reactions of

- i) Thietanes
- ii) Oxadiazoles
- iii) Quinolines

OR

B) Discuss the structure, synthesis and reactions of

- i) Selenophenes
- ii) Pyrans
- iii) Azepins.

(4×6=24)

K17P 1301

Reg. No. :

Name :

Third Semester M.Sc. Degree (Reg./Suppl./Imp.) Examination,
November 2017

CHEMISTRY

CHE3C.09 : Organic Chemistry – III
(2014 Admn. Onwards)

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **all** questions in **one** word or **one** sentence. **Each** question carries **one** mark.

1. Benzaldehyde absorbs at a lower wavelength than cinnamaldehyde. True or false ?
2. Amide carbonyl absorption is at lower frequency in FTIR. Why ?
3. Why are enolic hydrogens deshielded in ^1H NMR spectrum ?
4. How many lines are observed in the ^{13}C NMR of CDCl_3 ?
5. Benzaldehyde shows a base peak at 105 and a fragment peak at 29. What does these correspond to ?
6. An alkyl halide shows two peaks of the same intensity at 94 and 96. What is its structure ?
7. What is the major product formed when benzophenone reacts with isopropene in presence of light ?
8. What is the best method to prepare 1, 2, 3-triazole ?

SECTION - B



Answer **any eight** questions. Answer may be **two or three** sentences. **Each** question carries **two** marks.

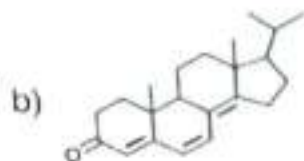
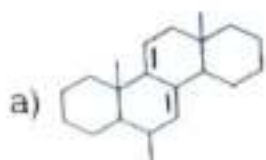
9. 1-Butene shows two strong stretchings in its IR at 3320 and 2180 cm^{-1} . What does these correspond to?
10. Butadiene shows a higher λ_{max} of absorption in UV than ethylene. Why?
11. How can the presence of an OH in a compound be confirmed using NMR spectroscopy?
12. A compound $\text{C}_9\text{H}_{10}\text{O}_2$ shows the following ^1H NMR values :
 δ 7.98 (2H, d), 7.45 (2H, d), 3.82 (3H, s) and 2.3 (1H, s).
Identify the structure.
13. What is McLafferty rearrangement?
14. If butane is the carrier gas used in the CIMS of acetophenone, what is the value of the peak $[\text{M}+\text{C}_4\text{H}_9]$?
15. Provide the structures of benzo[b] furan and benzo[c] furan.
16. Illustrate the Fischer indole synthesis.
17. What difference will be observed in the IR spectrum of salicylaldehyde compared 4-hydroxy benzaldehyde?
18. Predict the ^{13}C NMR values and DEPT signals of the carbons in ethanol.
19. Acetophenone can be distinguished from 4-methyl benzaldehyde using mass spectroscopy. Justify the statement.
20. How can isoquinoline be synthesized?



SECTION - C

Short paragraph questions. Answer **any four** questions. **Each** question carries **three marks**.

21. Explain the effect of solvent polarity on the UV absorption of a ketone.
22. Predict the IR stretching frequencies of the following functional groups :
- CN
 - NH₂
 - NO₂ and
 - CHO.
23. Depict the 1D and 2D proton NMR of isopropyl acetate.
24. In a 500 MHz NMR spectrometer a proton resonates as a doublet with resonances at 1759 Hz and 1752 Hz. Calculate the chemical shift of the proton.
25. Explain the principle and working of ESIMS.
26. 1, 4-Dicarbonyl compounds are sources of 5-membered heterocycles. Justify the statement by providing 2 examples.
27. What are metastable ions ? What is its importance ?
28. Apply the Woodward-Fieser rules to calculate the maximum wavelength of absorption of the following molecules :





SECTION - D

Essay type questions. Answer **any four** questions. **Each** question carries **six** marks.

29. A) An α, β -unsaturated aldehyde C_3H_4O shows an absorption band with a maximum wavelength of 220 nm ($\epsilon = 10,000$). A solution of this shows an absorbance of 2 in a 1 cm cell. (i) Calculate the concentration of the aldehyde in g/L. (ii) What happens to the absorbance of this solution if the concentration is doubled?

OR

- B) Arrange the following in the order of increasing IR stretching frequencies :
Cyclobutene-1, 2-dione, cyclohex-2-enone, cyclopent-2-enone and tropone.
Explain your answer.

30. A) Molecular formula of a compound is $C_3H_6O_2$. IR spectrum shows signals at 2900 and 1727 cm^{-1} . Proton NMR signals are found as triplet, quartet and singlet at δ 1.2, 4.2 and 8 respectively. Elucidate the structure of the compound.

OR

- B) Elucidate the structure of two isomers A and B of molecular formula $C_8H_7BrO_2$. The proton NMR signals of A and B are as follows A : δ 2.6, s : 3 sets of ArH's, 2 sets of doublets 7.2 - 7.4 : 7.44 - 7.48 (dd) : 7.52 - 7.6 (dd). B : δ 2.6, symmetric aromatic protons, 7.6, d and 7.8, d. IR signal of A is at 1698 cm^{-1} and B is at 1688 cm^{-1} .

31. A) Explain the major ionization modes used in MS.

OR

- B) What spectroscopic techniques can be used to differentiate between 2-nitroaniline and 4-nitroaniline? Explain.

32. A) Illustrate the Hantzsch pyridine synthesis.

OR

- B) 1, 3-Dipolar cycloaddition is a major route for 5-membered heterocycle synthesis. Give examples and explain.
-