Total No. of Printed Pages—15

5 SEM TDC CHM M 1 (N/O)

2016

(November)

CHEMISTRY

(Major)

Course : 501

(Physical Chemistry—II)

(New Course)

Full Marks : 48

Pass Marks : 14

Time : 2 hours

The figures in the margin indicate full marks for the questions

1. Select the correct answer : 1×5=5

(a) The rate constant for the reaction $2N_2O_5 \rightarrow 4NO_2 + O_2$ is $3 \times 10^{-5}\ s^{-1}$. If the rate is $2 \cdot 4 \times 10^{-5}\ mol\ l^{-1} s^{-1}$, the concentration of N_2O_5 (in mol l^{-1}) is

(i) 1·4

(ii) 1·2

(iii) 0·8

(iv) 0·04

(Turn Over)

(b) Each substance in a given state has a tendency to escape from that state and this escaping tendency is called

(i) spontaneity

(ii) Gibbs free energy

(iii) fugacity

(iv) activity

(c) Which of the following will have the highest coagulating power for As_2S_3 colloid?

(i) PO_4^{3-}

(ii) SO_4^{2-}

(iii) Al^{3+}

(iv) Na^+

(d) The pair of the solutions which can be expected to be isotonic at the same temperature is

(i) 0·1 *M* urea and 0·1 *M* $CaCl_2$

(ii) 0·1 *M* $Ca(NO_3)_2$ and 0·1 *M* K_2SO_4

(iii) 0·1 *M* NaCl and 0·1 *M* Na_2SO_4

(iv) 0·1 *M* glucose and 0·2 *M* $MgCl_2$

(e) In an adsorption process, unimolecular layer is formed. It is

(i) physical adsorption

(ii) chemical adsorption

(iii) ion-exchange

(iv) chromatographic analysis

2. Answer any *five* questions : 2×5=10

(a) Prove that the half-life period of a first-order reaction is independent of the initial concentration of the reactant.

(b) State and explain Le Chatelier's principle.

(c) What is Henry's law? Describe it.

(d) In the reduction of nitric oxide, 50% of reaction was completed in 108 seconds when initial pressure was 336 mm Hg and in 147 seconds when initial pressure was 288 mm Hg. Find the order of the reaction.

(e) Describe Schultz-Hardy rule.

(f) Mention four important uses of adsorption phenomenon.

(g) 5 g of a substance of molar mass 200 is dissolved in 50 g solvent. The molar mass and vapour pressure of the solvent are 60 and 40 cm respectively. Find the vapour pressure of the solution.

UNIT—I

3. Answer any *two* questions : 6×2=12

(a) Give one example of consecutive reaction. Discuss the kinetics of first-order consecutive reaction

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$

Depict graphically the concentration of A, B and C with time. 1+4+1=6

(b) (i) Derive the integrated rate expression for the reaction $2A \rightarrow$ products. 3

(ii) Deduce the expression for half-life period of such a reaction. 2

(iii) Give an example of such type of reaction. 1

(c) (i) Discuss any one method of determining the order of a reaction. 3

(ii) Discuss the effect of temperature on the rate of a chemical reaction. 3

UNIT—II

4. Answer any *one* question : 5

(a) (i) Deduce the relation between osmotic pressure and vapour pressure lowering when a non-volatile solute is dissolved in a solvent. 3

(ii) Calculate the value of van't Hoff's factor of potassium ferricyanide solution when it is 50% dissociated. 2

(b) (i) State Nernst distribution law. How is the law modified when the solute undergoes association in one of the solvents? 3½

(ii) What thermodynamic function is responsible for osmosis and how? 1½

UNIT—III

5. Answer any *two* questions : 3½×2=7

(a) Explain the term 'chemical potential'. Derive Gibbs-Duhem equation for two-component system. 1+2½=3½

(b) Discuss the effects of temperature and pressure on chemical potential. 3½

(c) Derive an expression for the change of Gibbs potential for the following gaseous reaction

$$aA + bB + \cdots \rightleftharpoons cC + dD$$ 3½

2. Answer any *five* questions : 2×5=10

(a) Prove that the half-life period of a first-order reaction is independent of the initial concentration of the reactant.

(b) The solubility of $BaSO_4$ is $2 \cdot 33 \times 10^{-4}$ g ml^{-1} at 20 °C. Calculate the solubility product of $BaSO_4$ assuming that the salt is completely ionized.

(c) State and explain Henry's law.

(d) In the reduction of nitric oxide, 50% of reaction was completed in 108 seconds when initial pressure was 336 mm Hg and in 147 seconds when initial pressure was 288 mm Hg. Find the order of the reaction.

(e) Describe Schultz-Hardy rule.

(f) Mention four important uses of adsorption phenomenon.

(g) 5 g of a substance of molar mass 200 is dissolved in 50 g solvent. The molar mass and vapour pressure of the solvent are 60 and 40 cm respectively. Find the vapour pressure of the solution.

UNIT—IV

6. Answer any *one* question : 4

(a) Explain Freundlich's adsorption isotherm. In what respect Langmuir's isotherm is superior to Freundlich's adsorption isotherm? 3+1=4

(b) *(i)* Write any two differences between physical adsorption and chemical adsorption. 1

(ii) Discuss the important factors which affect the adsorption of a gas on a solid adsorbent. 3

UNIT—V

7. Answer any *one* question : 5

(a) *(i)* Discuss the origin of charges on colloidal particles. 2

(ii) Define zeta potential. 1

(iii) Discuss the mechanism of coagulation. 2

(b) (i) What are emulsions? Discuss giving example, the role of the emulsifier in the preparation of an emulsion. 1+2=3

(ii) Explain what will happen if a colloidal solution of $Fe(OH)_3$ is mixed with a colloidal solution of As_2S_3. 2

(Old Course)

Full Marks : 48
Pass Marks : 19

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Select the correct answer : 1×5=5

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(i) 1·4

(ii) 1·2

(iii) 0·8

(iv) 0·04

(b) NH_4OH is a weak base, but it becomes still weak in the aqueous solution of

(i) 0·1 *M* NH_4Cl

(ii) 0·1 *M* H_2SO_4

(iii) 0·1 *M* HCl

(iv) 0·1 *M* CH_3COOH

(c) Which of the following will have the highest coagulating power for As_2S_3 colloid?

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(ii) SO_4^{2-}

(iii) Al^{3+}

(iv) Na^+

(d) The pair of the solutions which can be expected to be isotonic at the same temperature is

(i) 0·1 *M* urea and 0·1 *M* $CaCl_2$

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(iii) 0·1 *M* NaCl and 0·1 *M* Na_2SO_4

(iv) 0·1 *M* glucose and 0·2 *M* $MgCl_2$

(e) In an adsorption process, unimolecular layer is formed. It is

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(ii) chemical adsorption

(iii) ion-exchange

(iv) chromatographic analysis

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(c) State and explain Henry's law.

(d) In the reduction of nitric oxide, 50% of reaction was completed in 108 seconds when initial pressure was 336 mm Hg and in 147 seconds when initial pressure was 288 mm Hg. Find the order of the reaction.

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UNIT—I

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(ii) Deduce the expression for half-life period of such a reaction. 2

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(c) *(i)* Discuss any one method of determining the order of a reaction. 3

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(Continued)

UNIT—II

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(ii) Calculate the value of van't Hoff's factor of potassium ferricyanide solution when it is 50% dissociated. 2

(b) *(i)* State Nernst distribution law. How is the law modified when the solute undergoes association in one of the solvents? 3½

(ii) What thermodynamic function is responsible for osmosis and how? 1½

UNIT—III

5. Answer any *two* questions : 3½×2=7

(a) Derive an expression for the pH of an aqueous solution of salt of a strong acid and a weak base. 3½

(b) What is buffer solution? Derive an expression for calculating the pH of a basic buffer solution. 1+2½=3½

(c) (i) Find the relation between solubility and solubility product for As_2S_3. 1½

(ii) Describe the application of solubility product in qualitative analysis with two examples. 2

UNIT—IV

6. Answer any *one* question : 4

(a) Explain Freundlich's adsorption isotherm. In what respect Langmuir's isotherm is superior to Freundlich's adsorption isotherm? 3+1=4

(b) (i) Write any two differences between physical adsorption and chemical adsorption. 1

(ii) Discuss the important factors which affect the adsorption of a gas on a solid adsorbent. 3

UNIT—V

7. Answer any *one* question : 5

(a) (i) Discuss the origin of charges on colloidal particles. 2

(ii) Define zeta potential. 1

(iii) Discuss the mechanism of coagulation. 2

(Continued)

(b) (i) What are emulsions? Discuss giving example, the role of the emulsifier in the preparation of an emulsion. 1+2=3

(ii) Explain what will happen when a colloidal solution of $Fe(OH)_3$ is mixed with a colloidal solution of As_2S_3. 2

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2016

(November)

CHEMISTRY

(Major)

Course : 503

(Inorganic Chemistry—II)

The figures in the margin indicate full marks for the questions

(New Course)

Full Marks : 48
Pass Marks : 14
Time : 2 hours

1. Select the correct answer from the following : 1×5=5

(a) The total electron count for the compound $Fe_5C(CO)_{15}$ is

(i) 62
(ii) 72
(iii) 74
(iv) 86

(b) Which of the following does not obey 18-electron rule?

(i) $Fe(CO)_2$ (σ-C_5H_5) (π-C_5H_5)

(ii) $Mn(CO)_5(CH_3)$

(iii) $Co_2(CO)_8$

(iv) $Mn(CO)_6$

(c) Sodium nitroprusside contains species

(i) NO (ii) NO^+

(iii) NO^- (iv) NO_2

(d) $Mn(CO)_5$ is isolobal with

(i) CH (ii) CH_2

(iii) CH_2^+ (iv) CH_3

(e) 1,10-phenanthroline iron (II) sulphate may be used as

(i) adsorption indicator

(ii) metal ion indicator

(iii) redox indicator

(iv) neutralization indicator

2. Answer the following questions : 2×5=10

(a) What do you mean by oxidative addition reaction?

(b) How will you detect bridging and terminal CO in $Fe_2(CO)_9$?

(c) What are metal cluster compounds? Give examples.

(d) Explain why two nitrosyl groups can substitute three carbonyl group from metal carbonyl compounds.

(e) Write a note on adsorption indicator.

3. Answer any *three* questions : 3×3=9

(a) Give two important reactions of ferrocene from which the aromatic character of the molecule can be established. 3

(b) Explain reductive elimination reaction with suitable example. 3

(c) What do you mean by heptacity of a ligand in organometallic compound? Give the name and formula of one monohepto and one pentahepto ligand. 3

(d) Discuss about the bonding in mononuclear metal carbonyls. 3

(e) How will you prepare the following? 1½×2=3

(i) $Fe(\eta^5\text{-}C_5H_5)_2$

(ii) Zeise's salt

4. Answer any *three* questions : 3×3=9

(a) What are low nuclearity carbonyl clusters? Discuss the structure of one such cluster. 1+2=3

(b) Predict the structure of the following clusters in the light of PSEP theory : 1½×2=3

(i) $Co_4(CO)_{12}$

(ii) $[Fe_4C(CO)_{12}]^{2-}$

(c) What are nitrosyl complexes? Give one example of nitrosyl complex formed by Fe and Co. 2+1=3

(d) Outline the rules for polyhedral skeletal electron pair theory. 3

5. Answer any *three* questions : 3×3=9

(a) Define accuracy, precision and mean deviation. 3

(b) What indicator will you use in the titration of *(i)* strong acid with weak base and *(ii)* strong acid with strong base? Give reasons. 1½+1½=3

(c) What are metal ion indicators? Give two examples with structure. 1+2=3

(d) What are determinate and indeterminate errors? In a determination, the concentration of iron in a given sample was found to be 20·17 ppm. Taking the accepted value as 20·00 ppm, calculate the absolute error and the relative error as percent in the determination. 1+2=3

6. Discuss the use of the following reagents in inorganic analysis (any *three*) : 2×3=6

(a) Cupferron

(b) Magneson

(c) Dithizone

(d) 1,10-phenanthroline

(e) Zinc uranyl acetate

(Old Course)

Full Marks : 48
Pass Marks : 19

Time : 3 hours

1. Select the correct answer from the following : 1×5=5

(a) The stretching wave number of the CO molecule is $2143\ cm^{-1}$. The C—O stretching wave number of CO in $Ni(CO)_4$ is

(i) $2060\ cm^{-1}$

(ii) $2160\ cm^{-1}$

(iii) $2260\ cm^{-1}$

(iv) $2243\ cm^{-1}$

(b) $Mn(CO)_5$ is isolobal with

(i) CH_2 *(ii)* CH_3

(iii) CH_2^+ *(iv)* CH

(c) The total electron count of a cluster is $12(n-2)+2(n+1]$. The structure will be

(i) hypo

(ii) arachno

(iii) nido

(iv) closo

(d) Sodium nitroprusside contains species

(i) NO_2 (ii) NO

(iii) NO^+ (iv) NO^-

(e) Which of the following is a redox indicator?

(i) Methyl orange

(ii) Congo red

(iii) Thymol blue

(iv) Methylene blue

2. Answer the following questions : 2×5=10

(a) Explain oxidative addition reaction with the help of Vaska's compound.

(b) Mention the conditions necessary for isolobality of two molecular fragments.

(c) $Fe_2(CO)_9$ contains both bridging and terminal CO. Justify the statement.

(d) Explain why two nitrosyl groups can substitute three carbonyls groups from metal carbonyl compounds.

(e) What do you mean by an error? How are they expressed?

3. Answer any *three* questions : 3×3=9

(a) What do you mean by reductive elimination? Give an example.

(b) Give the reaction path of the hydrogenation of olefin with the help of Wilkinson's catalyst.

(c) Describe briefly the structure of *bis*-(cyclopentadienyl) iron (II).

(d) Discuss about the bonding in mononuclear metal carbonyls.

(e) Give the preparation of the following :

(i) $Fe(C_5H_5)_2$

(ii) Zeise's salt

4. Answer any *three* questions : 3×3=9

(a) What are low nuclearity carbonyl clusters? Discuss the structure of one such cluster. 1+2=3

(b) Outline the rules for polyhedral skeletal electron pair theory. 3

(c) Explain how nitric oxide form metal complexes as *(i)* 3-electron donor, *(ii)* 2-electron donor and *(iii)* 1-electron donor. Give one example of each. 3

(d) Predict the structure of the following clusters in the light of PSEP theory : 1½×2=3

(i) $Co_4(CO)_{12}$

(ii) $[Fe_4C(CO)_{12}]^{2-}$

5. Answer any *three* questions : 3×3=9

(a) What are metal ion indicators? Give two examples with structure. 1+2=3

(b) Explain additive and proportional errors. 1½+1½=3

(c) What indicator will you use in the titration of *(i)* strong acid and weak base, and *(ii)* strong acid and strong base? Give reasons. 1½+1½=3

(d) In a set of measurements, the following concentrations of Fe (ppm) were reported :

20·2, 20·4, 20·3, 20·1, 19·9, 20·0, 19·8

Calculate mean deviation and standard deviation. 3

6. Discuss the use of the following reagents in inorganic analysis (any *three*) : 2×3=6

(a) Cupferron

(b) Magneson

(c) Dithizone

(d) 1,10-phenanthroline

(e) Zinc uranyl acetate

★★★

Total No. of Printed Pages—15

5 SEM TDC CHM M 5 (N/O)

2016

(November)

CHEMISTRY

(Major)

Course : 505

(Organic Chemistry)

The figures in the margin indicate full marks for the questions

(New Course)

Full Marks : 48

Pass Marks : 14

Time : 2 hours

1. *(a)* Select the correct answer of the following : 1×3=3

(i) Which of the following pairs give the same osazone?

(1) Sucrose, Fructose

(2) Mannose, Fructose

(3) Glucose, Galactose

(4) Maltose, Lactose

(ii) The enzyme which hydrolyzes triglycerides to fatty acids and glycerol is called

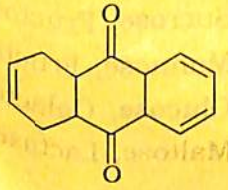
(1) maltase
(2) zymase
(3) lipase
(4) pepsin

(iii) In DNA, the complementary bases are

(1) adenine and guanine; thymine and cytosine
(2) uracil and adenine; cytosine and guanine
(3) adenine and thymine; guanine and cytosine
(4) adenine and thymine; guanine and uracil

(b) Draw the structure of Ranitidine (Zantac). 1

(c) What dienes and dienophiles would you employ to synthesize the following compound? 1



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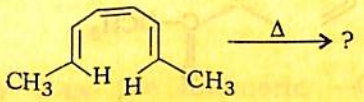
UNIT—I

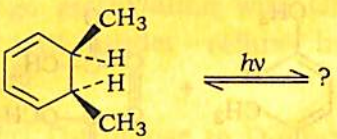
Answer *any* **one** question

2. *(a)* Predict the stereochemical products obtained in the following electrocyclic reactions (any *one*) : 1

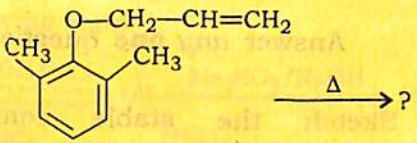
(i)



(ii)



(b) Complete the following reaction and discuss the mechanism involved : 3

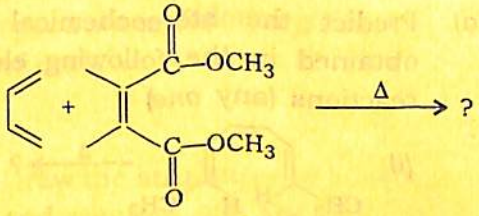


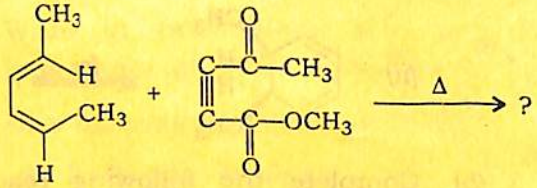
(c) Explain briefly as to how a conjugated diene under photochemical conditions undergoes cyclization via a disrotatory path. 3

3. *(a)* How would you convert *trans*-5,6-dimethyl-1,3-cyclohexadiene into its *cis*-isomer? 2

(b) Draw the MO of 1,3-butadiene indicating HOMO in the ground and excited state. 3

(c) Write the products with stereochemistry in the following Diels'-Alder reaction (any *one*) : 2

(i) 

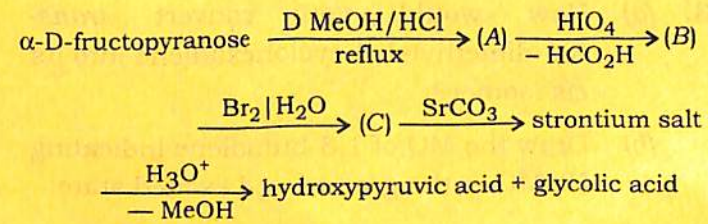
(ii) 

UNIT—II

Answer *any* **one** question

4. (a) Sketch the stable conformational structure of the anomer of α-D-gluco-pyranose. 2

(b) Explain the products obtained in the following periodic oxidation of α-D-fructopyranose : 3



(c) Explain that C-2 epimeric aldoses give the same lower aldose by Ruff degradation. 3

(d) What is epimerization? Explain it considering the conversion of D-mannose to D-glucose. 3

5. (a) Why does the anomeric —OH group undergo methylation with CH_3OH and with HCl under reflux but others do not? 2

(b) Convert D-fructose to D-glucose. 3

(c) Determine whether D-glucose is in a furanose or a pyranose form from the following data : 4

$$\text{D-glucose} \xrightleftharpoons{MeOH/HCl} (A) \xrightarrow{Me_2SO_4/NaOH} (B)$$

$$\xrightarrow{\text{dil.HCl}} (C) \xrightarrow{HNO_3} \text{(Methoxy malonic acid + Dimethoxy glyceric acid + dimethoxy succinic acid + Methoxy acetic acid)}$$

(d) $$\text{Erythrose} \xrightarrow{KCN} \xrightarrow[H_2SO_4]{Ba^{+2}} \xrightarrow{\Delta} \xrightarrow[H_3O^+]{Na/Hg} (A) + (B)$$

$$(A) \xrightarrow{HNO_3} \text{Dibasic acid (optically active)}$$

$$(B) \xrightarrow{HNO_3} \text{Dibasic acid (optically inactive)}$$

Identify *A* and *B*. 2

UNIT—III

Answer *any* **one** question

6. *(a)* Synthesize one important pyrimidine base present only in RNA. 3

(b) How are enzymes classified on the basis of their functions? 3

(c) How does DNA replicate? How is the process responsible for preservation of heredity? 3

7. *(a)* What are complementary bases? Draw the structure to show hydrogen bonding between adenine—thymine and guanine—cytosine. 3

(b) Write a short note on coenzyme. 3

(c) Discuss the double-helical structure of DNA. 3

UNIT—IV

Answer *any* **one** question

8. *(a)* Synthesize a drug which is used to bring down body temperature during fever. 2

(b) Draw the structure of chloramphenicol. What type of drug is it? 1+1=2

(c) Sulpha drugs work like antibiotics but they are not antibiotics. Is this a valid statement and why? 2½

(d) Name the food sources and the deficiency diseases caused due to lack of vitamin C. 2½

9. (a) Write in brief about the medicinal importance of curcumin. 2

(b) Carry out the synthesis of an antimalarial-chloroquine using the following sequential steps : 1½+1½+1=4

Step I : Synthesis of 5-dimethylamino-2-amino pentane from AAE.

Step II : Synthesis of 4,7-dichloro-quinoline from *m*-chloroaniline and oxalyl acetic ester.

Step III : Synthesis of chloroquine from above amino and quinoline derivatives.

(c) Name the chemical responsible for antiseptic properties of Dettol. 1

(d) Synthesize sulphanilamide from sulphanilic acid. 2

UNIT—V

Answer *any* **one** question

10. *(a)* Synthesize (±) α-terpineol from *p*-toluic acid. 3

(b) Establish the structure of citral on the basis of analytical and synthetic evidences. 4

11. *(a)* What are geraniol and nerol? How would you assign their configuration? 1+2=3

(b) Complete the following oxidative degradation reactions of α-terpineol : 4

α-terpineol (C_{10}) $\xrightarrow{1\%\ \text{alk. } KMnO_4}$ trihydroxy compound (C_{10})

$\xrightarrow{CrO_3 \text{ in AcOH}}$ [ketohydroxy acid] (C_{10}) $\longrightarrow$

ketolactone (C_{10}) $\xrightarrow{\text{warm, alk. } KMnO_4}$ terpenylic acid (C_8)

$\xrightarrow{KMnO_4}$ terebic acid (C_7)

(Old Course)

Full Marks : 48

Pass Marks : 19

Time : 3 hours

1. *(a)* Select the correct answer of the following : 1×3=3

(i) Glucose is stored in our body as

(1) carbohydrate

(2) fat

(3) glycogen

(4) lipid

(ii) The relationship between the nucleotide triplets and the amino acid is called

(1) enzyme

(2) genetic code

(3) replication

(4) mutation

(iii) The function of enzymes in the living system is to

(1) provide energy

(2) transport oxygen

(3) provide immunity

(4) catalyze biochemical reaction

(b) What type of drug is chloramphenicol? 1

(c) Giving one example, state isoprene rule. 1

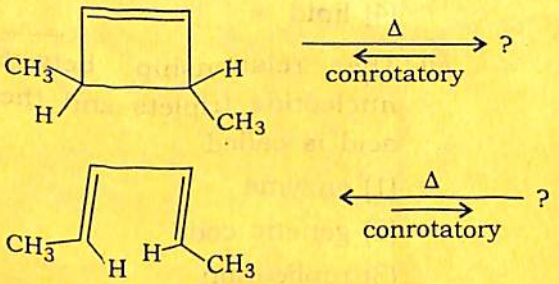
UNIT—I

Answer *any* **one** question

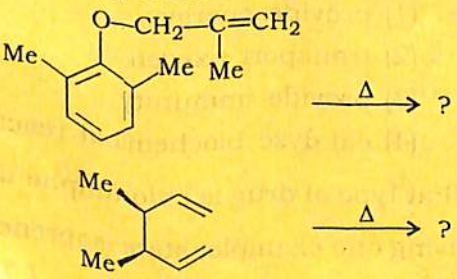
2. *(a)* Draw the π-orbital diagrams for the ground state of 1,3-butadiene indicating HOMO. 3

(b) Explain that [4+2] cycloaddition is photochemically forbidden. 2

(c) What stereochemical products are obtained in the following reactions (any *one*)? 2



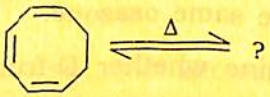
3. *(a)* What is sigmatropic rearrangement? Predict the products obtained in the following reactions : 1+1+1=3



(Continued)

(b) What is meant by a pericyclic reaction? With the help of FMO approach, show that Diels'-Alder reaction is a concerted stereospecific reaction. 1+2=3

(c) Complete the following electrocyclic reaction : 1



UNIT—II

Answer *any* **one** question

4. (a) Represent β-D-fructopyranose in Haworth projection and its stable conformation. 2

(b) Convert D-ribose to a pair of epimeric-D-aldohexoses by using Fischer-Kiliani synthesis. 3

(c) Explain that both α-D-glucopyranose and α-D-allopyranose give the same strontium salt, having same specific rotation, by using periodic oxidation. 4

α-D-glucopyranose
or
α-D-allopyranose

$$\xrightleftharpoons{MeOH/HCl} ? \xrightarrow{HIO_4} ? \xrightarrow{Br_2|H_2O} ? \xrightarrow{SrCO_3} \text{strontium salt having same specific rotation}$$

(d) Complete the following reactions : 2

$$\text{D-glucopyranose} \xrightarrow[or\ NaBH_4]{Na\text{-}Hg/H_2O} \text{optically active glucitol} \xrightarrow{HI/red\ P} ?$$

5. (a) Explain why D-glucose and D-fructose give the same osazone. 1½×2=3

(b) Determine whether D-fructose is in a furanose or a pyranose form from the following evidences : 4

$$\text{D-fructose } C_6H_{12}O_6 \underset{}{\overset{MeOH/HCl}{\rightleftharpoons}} (A) \xrightarrow[NaOH]{excess\ Me_2SO_4} (B) \xrightarrow{dil.\ HCl} (C)$$

$$\xrightarrow{dil.\ HNO_3} (D) \xrightarrow[H_2SO_4]{KMnO_4} \delta\text{-lactone} \xrightarrow[HNO_3]{oxidation}$$

Arabinotrimethoxy glutaric acid

(c) What happens when allopyranose reacts with acetone in presence of H_2SO_4? 2

(d) Convert D-fructose to epimeric aldohexoses. 2

UNIT—III

Answer *any* **one** question

6. (a) Draw the structures of the—

(i) nucleoside of guanosine;

(ii) nucleotide of AMP. 1+1=2

(Continued)

(b) How would you synthesize thymine from urea or thiourea? 2

(c) What kinds of specificity the enzymes display in their action? 2

(d) State the constitutional differences between DNA and RNA. Write down the names of the bases produced on hydrolysis of DNA. 2+1=3

7. (a) Synthesize one important purine present in both DNA and RNA. 2

(b) Write a note on replication of DNA. 2

(c) In what ways enzymes differ from a typical inorganic catalyst? Outline the steps in an enzyme-catalyzed reaction. 1+2=3

(d) Distinguish between nucleotide and nucleoside. 2

UNIT—IV

Answer *any* **one** question

8. (a) Draw the structure of Ibuprofen. Give one important use of it. 2

(b) How do the sulpha drugs prevent the growth and multiplication of bacteria when administered into a host body? 3

(c) Synthesize a drug which can be used as analgesic and antipyretic from phenol. 2

(d) Define broad spectrum and narrow spectrum antibiotics giving one example of each. 2

9. (a) Draw the structures of sulphaguanidine and mention one specific use of it. 1+1=2

(b) Write in brief about the medicinal importance of Azadirachtin (Neem). 2

(c) Give the preparation of the following : 2+2=4

(i) Ibuprofen by using green method

(ii) Paracetamol

(d) What is tincture of iodine? What is its use? 1

UNIT—V

Answer *any* **one** question

10. (a) How would you synthesize α-terpineol from diethyl malonate? 3

(b) Complete the following reactions : 2

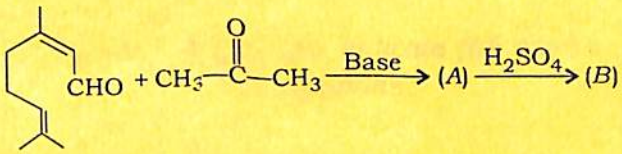
$$\underset{C_{10}H_{16}O}{\text{Citral}} \xrightarrow{H_2/\text{cat.}} (A) \xrightarrow[CrO_3]{\text{oxidation}}$$

a dicarboxylic acid + a ketone

(c) What happens when nerol is treated with dil. H_2SO_4? Write the mechanism of the reaction involved. 2

11. (a) How will you establish the position of double bonds (α, β and isolated) in citral? 2

(b) Predict the products obtained in the following sequence of reactions : 2



(c) Complete the following reactions : 3

6-Methylhept-5-en-2-one $\xrightarrow[\text{Reformatsky reaction}]{\text{Zn/A bromoester}}$ (A)

$\xrightarrow{Ac_2O}$ $\xrightarrow[\text{+ calcium formate}]{\text{calcium salt}}$ Citral

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Total No. of Printed Pages—3

5 SEM TDC CHM M 6 PR A (Both N/O)

2016

(November)

CHEMISTRY

(Major)

Course : 506

(Organic Lab)

(Practical)

(Both New and Old Course)

Full Marks : 32

Pass Marks : 13 (Backlog)/10 (2014 onwards)

Time : 6 hours

PART—A

Instructions to Examiners

1. Organic quantitative analysis : 23

Determination of amount of glucose :

Prepare a stock solution by dissolving 22·5 g of accurately weighed AR glucose in a 250 ml volumetric flask with distilled water and make up to the mark.

Give between 20-25 ml of this solution to each student in 250 ml volumetric flask.

(Different volumes for each student)

For estimation of the amount of glucose use Fehling's solution method.

Procedure for estimation may be supplied.

N.B. : Weights and burette readings are to be noted during the practical works.

Distribution of Marks :

(i)	Theory	4
(ii)	Preparation of solutions and standardization	4
(iii)	Completion of experiments including calculation	5
	Error up to ± 1%	10
	± 2%	8
	± 3%	6
	± 4%	4
	± 5%	2

Above 5% error, no marks are to be allotted. Range of 0·5% carries 1 mark.

2. Detection of adulterants in common food-stuff : 5

(a) Starch in milk

(b) Argemone oil in mustard oil

(c) Invert sugar in honey

(d) Lead chromate in turmeric powder

(e) Metanil yellow in haldhi or arhar dal

3. Viva voce. 4

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Total No. of Printed Pages—12

5 SEM TDC CHM M 7 (N/O)

2016

(November)

CHEMISTRY

(Major)

Course : 507

(Symmetry and Quantum Chemistry)

(New Course)

Full Marks : 48
Pass Marks : 14

Time : 2 hours

The figures in the margin indicate full marks for the questions

1. Select the correct answer from the following : 1×5=5

(a) In MO method, the orbitals are represented by the symbols

(i) n, l, m

(ii) s, p, d, f

(iii) π, p_x, p_y, p_z

(iv) $\sigma, \pi, \sigma^*, \pi^*$

(b) When scattering angle $\phi = 0$, then Compton shift will be

(i) zero

(ii) 0·0242 Å

(iii) 0·0484 Å

(iv) 0·0726 Å

(c) The number of nodes in the radial probability distribution curve of s-orbital of any energy level is equal to

(i) $\frac{n}{2}$

(ii) $n-1$

(iii) $n-2$

(iv) $n-l-1$

(d) The normalized wave function for a particle in one-dimensional box is

(i) $\sqrt{\frac{8}{l^3}} \sin \frac{n\pi x}{l}$

(ii) $\left(\frac{2}{l}\right)^{1/2} \sin \frac{n\pi x}{l}$

(iii) $\frac{h^2}{8ml^2}$

(iv) $\left(\frac{1}{l}\right)^{1/2} \sin \frac{n\pi x}{l}$

(e) NO_2 molecule has symmetry elements E, C_2, σ_v, σ'_v, the point group to which it belongs is

(i) C_{2v}

(ii) C_{3v}

(iii) $C_{\infty v}$

(iv) D_{2h}

2. Answer any *five* questions from the following : 2×5=10

(a) Write down the Hamiltonian operators for H_2^+ and H_2 molecule.

(b) Explain rotation-reflection axis (s_n) in symmetry.

(c) Explain why the bond order of H_2^- is less than that of H_2.

(d) Show that e^{-ax^2} (a is a constant) is an eigenfunction of operator $\frac{1}{x} \cdot \frac{d}{dx}$. Find the eigenvalue.

(e) Explain the distribution of energy in the spectrum of a black-body radiation.

(f) Calculate the energy required for a transition from $n_x = n_y = n_z = 1$ to $n_x = n_y = 1$, $n_z = 2$ for an electron in a cubic hole of a crystal having edge length 1Å.

(g) Calculate the zero-point vibrational energy of a one-particle, one-dimensional system, if $E_v = \left(v + \frac{1}{2}\right)\hbar\omega_0$.

UNIT—I

3. Answer any *three* questions from the following : 3×3=9

(a) What is multiplication table? Construct the multiplication table for C_{2v} point group.

(b) With a neat sketch, find the symmetry elements, operations and point groups of the following :

$$[PtCl_4]^{2-},\ CO_2,\ BF_3$$

(c) State, without any derivation, the five rules about irreducible representation of a group and their characters by making use of 'great orthogonality theorem'.

(d) Give the reducible representation of character table for C_{3v} point group.

UNIT—II

Answer any *two* questions : 9×2=18

4. *(a)* Explain the meaning of the term 'degenerate energy levels' by taking the example of particle in a cubical box. What would happen to the degeneracy when the cubical box is distorted? 3

(b) Evaluate the expectation value of energy of a particle in a one-dimensional box of width a and infinite height with potential energy zero inside the box. 4

(c) What do you understand by an orthonormal set of wave functions? 2

5. *(a)* For a particle of mass m in a one-dimensional box of length a, show that ψ_1 and ψ_2 are orthogonal. 4

(b) What are linear and Hermitian operators? Give one example of each. 3

(c) Write down the equation showing Hamiltonian operator for one-dimensional harmonic oscillator. 2

6. *(a)* The distance between the atoms of a diatomic molecule is r and its reduced mass is μ. If its angular momentum is L and moment of inertia is I, prove that

$$\text{kinetic energy, } T = \frac{L^2}{2\mu I^2} \qquad 3$$

(b) Prove that 1s wave function of hydrogen atom given by

$$\psi_{1s} \text{ i.e. } \psi_{1,0,0} = \frac{1}{\sqrt{\pi} a_0^{3/2}} e^{-r/a_0}$$

is a normalized wave function where a_0 represents Bohr radius. 4

(c) Write down Schrödinger wave equation for H-atom. 2

UNIT—III

7. *(a)* Taking suitable trial wave function for hydrogen molecule ion, obtain the expressions for the possible energies and the corresponding eigenfunctions for the system. 4

Or

Give the ground state molecular orbital configuration of CN and CN^+. State also their bond order and magnetic character. 4

(b) Write the differences between bonding and antibonding molecular orbitals. 2

(Old Course)

Full Marks : 48
Pass Marks : 19

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Select the correct answer from the following : 1×5=5

(a) The quantum number accounts for the Zeeman effect is

(i) magnetic quantum number

(ii) azimuthal quantum number

(iii) spin quantum number

(iv) None of the above

(b) The operator corresponding to the total energy of a system, written as a sum of kinetic and potential energies is called

(i) momentum operator

(ii) kinetic energy operator

(iii) Hamiltonian operator

(iv) None of the above

(c) Bonding energy of a diatomic molecule depends on

(i) internuclear repulsions

(ii) nuclear electronic attractions

(iii) interelectronic repulsions

(iv) All of the above

(d) The maximum kinetic energy of the photoelectrons varies directly with

(i) intensity

(ii) frequency

(iii) wavelength

(iv) None of the above

(e) A molecule belonging to C_{3v} point group possesses

(i) E, $2C_3$ and $3\sigma_v$

(ii) E, $2C_3$ and $2\sigma_v$

(iii) E, $3C_3$ and $2\sigma_v$

(iv) E, $3C_3$ and $3\sigma_v$

2. Answer any *five* questions from the following : 2×5=10

(a) Discuss the following with reference to symmetry elements and symmetry operations :

(i) $CHCl_3$

(ii) CO_2

(b) Discuss the symmetry elements and symmetry operations of BF_3.

(c) Calculate the eigenvalue of the function $\psi = \cos 5x$, where the operator $\frac{d^2}{dx^2}$ is operated upon it.

(d) Discuss orthogonality with the following functions :

(i) $\left(\frac{1}{\pi}\right)^{1/2} \cos nx$

(ii) $\left(\frac{1}{\pi}\right)^{1/2} \sin nx$

(e) Hermitian operators have real eigenvalues. Explain.

(f) Taking water as an example of symmetric angular molecule, discuss symmetry operations in C_{2v} point group molecule.

UNIT—I

3. Answer any *three* questions from the following : 3×3=9

(a) Write short notes on symmetry elements and point group.

(b) Construct the character table for C_{2v} point group.

(c) Determine Γ_v for C_{3v} point group.

(d) State, without derivation, the five rules about irreducible representation of a group and their characters by making use of 'great orthogonality theorem'.

(e) A group has the following irreducible representations :

$$A_1, A_2, B_1, B_2, E_1, E_2$$

(i) What is the order of the group?

(ii) How many classes are there in the group?

UNIT—II

Answer any *two* questions : 9×2=18

4. *(a)* What are eigenfunctions and eigenvalues? Normalize the function $\psi = x^3$ over the interval $0 \leq x \leq k$, where k = constant. 3

(Continued)

(b) Sketch ψ and ψ^2 for the states $n = 2, 3, 4$ of a particle in a one-dimensional box. 3

(c) Solve Schrödinger's wave equation for a particle in a one-dimensional box and find its energy. 3

5. (a) State two postulates of quantum mechanics. 2

(b) A particle of mass m is confined in a one-dimensional box of length a. Calculate the probability of finding the particle in the region $0 \leq x \leq \frac{a}{3}$. What is the limiting probability when $x \to \infty$? 3

(c) Write a short note on radial and angular parts of wave functions. 4

6. (a) A helium atom is in excited state. It has two electrons a and b. One electron is in 1s orbital while the other is in 2s orbital.

(i) Give the two possible wave functions (ψ).

(ii) Mention all four product combinations of the orbital and spin wave functions if the spins are α and β. 3

(b) State two significant experimental observations concerning photoelectric effect. Explain the observations with the help of classical theory or any other theory of light. 3

(c) Derive a dimensionless algebraic equation for harmonic oscillator by quantum mechanical treatment. 3

UNIT—III

7. (a) What are the main differences between VBT and MOT? 2

(b) Explain why H_2 molecule is more stable than H_2^+ molecule. 2

(c) Draw the MO energy-level diagram for any one of the following and find the bond order : 2

(i) NO^+ molecule

(ii) N_2 molecule

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