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13

[This question paper contains 7 printed pages]

Your Roll No. : 2019

Sl. No. of Q. Paper : **2204** **IC**

Unique Paper Code : 32171601

Name of the Course : **B.Sc. (Hons.) Chemistry**

Name of the Paper : Inorganic Chemistry IV

Semester : VI

Time : 3 Hours ***Maximum Marks : 75***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Attempt any **five** questions.

(c) Question **No. 1** is compulsory.

(d) **All** questions carry equal marks.

1. Answer any **fifteen** questions from the following : 1×15=15

(i) Explain why CO is referred to as a π acid ligand.

(ii) $Fe(CO)_5$ is known while $[Fe(CO)_6]$ is not. Why ?

P.T.O.

(iii) Give the valence electron count of the metal in :

(a) $[Mn_2(CO)_{10}]$,

(b) $[Fe(\pi\, C_5H_5)(CO)]$,

(iv) Which is more basic towards a proton – $[Mn(CO)_5]^-$, $[Re(CO)_5]^-$

(v) What is meant by π acidity ?

(vi) Iron forms a pentacarbonyl but nickel forms a tetracarbonyl. Explain why ?

(vii) Name an important biomolecule containing cobalt.

(viii) Name the enzyme catalyzing this reaction $H_2O + CO_2 \rightleftharpoons H_2CO_3$

(ix) Give the name and chemical formula of the yellow precipitate obtained in the confirmatory test of potassium ions.

(x) Why is the Group II centrifugate boiled with a few drops of concentrated nitric acid before proceeding to Group III ?

(xi) Is the given compound organometallic compound ?

$Ti(CH_3)(OEt)_3$, $Al(OMe)_3$

(xii) Name a disease associated with cobalt deficiency.

Fill in the blanks :

(xiii) In the key step of the cycle of Ziegler Natta catalysis, ethene forms a .....with titanium.

(xiv) The rhodium complex used as Wilkinson's catalyst has the formula .....

(xv) Interfering ions must be removed before making the solution ..... for the precipitation of Group .....

(xvi) A common antidote for arsenic is .....

(xvii) The biomolecule involved in taking Fe from its storage sites to the sites for incorporation into haemoglobin is.....

2. (a) The cyclopentadienyl rings in ferrocene have aromatic character but cyclopentadiene itself has no such character. Explain. 5

(b) Draw the structure of dimeric trialkyl aluminium and explain why all Al – C bond lengths are not identical. 5

(c) (i) Which is more stable and why: $[Fe(\eta^5\text{–}C_5H_5)_2]$ or $[Co(\eta^5\text{–}C_5H_5)_2]$? 5

(ii) How will you prepare aminoferrocene from ferrocene ? 5

3. (a) (i) Despite having similar size and charge Zn(II) is an important biocatalyst in comparison to Cu(II), comment. 5

(ii) Which metal is present at the active site of the enzyme Carboxypeptidase A ? What is its coordination number and how it is satisfied ? 5

(b) What is an ion pump ? Show how the sodium potassium pump maintains the concentration gradient of the relevant ions as well as the charge gradient across the cell membrane. 5

(c) (i) Why does a minute concentration of vanadate inhibit the operation of the ATPase in the sodium - potassium pump ?

(ii) When EDTA is used for detoxification it is administered as the calcium salt. Why ? 5

4. (a) Give any **two** methods of preparation of metal carbonyls. What happens when $Fe(CO)_5$ reacts with bromine ? 5

(b) Two different structures of $Co_2(CO)_8$ are consistent with 18 electron rule. How will you predict the structure on the basis of IR studies ? 5

(c) Draw the structure of the anion of Zeise's salt and briefly discuss the nature of bonding. Give two evidences to indicate that back bonding occurs in this compound. 5

5. (a) Can Wilkinson's catalyst be used to produce enantioselective products ? Give an example. 5

(b) Differentiate between *homogeneous* and *heterogeneous* catalysis giving examples of each and mention **one** advantage and **one** disadvantage of each. 5

(c) Name the two gases involved in the formation of synthetic gasoline by Fischer-Tropsch process. What is the name given to the mixture of these gases ? 5

6. (a) An unknown salt **A**, when heated with NaOH solution, produced a pungent smelling gas **B**. **B** turned red litmus blue and gave dense white fumes of **C** when a glass rod dipped in HCl was held at the mouth of the test tube. **A**, on heating with concentrated sulphuric acid, gave a mixture of two odourless gases **D** and **E**. **D** burnt with a blue flame while **E** turned lime water milky. An aqueous solution of **A** gave a white precipitate with calcium chloride solution, the acid extract of which discharged the colour of acidified potassium permanganate solution. Identify **A**, **B**, **C**, **D** and **E** giving the reactions involved. 5

(b) (i) How can sulphite ions and carbonate ions be tested for in presence of each other in qualitative analysis ?

(ii) How can Cu^{2+} and Ni^{2+} ions present in a mixture be separated on the basis of common ion effect ? 5

(c) (i) Pb(II) ions are included in both Group I and Group II cations in qualitative inorganic analysis. Give reasons.

(ii) Limewater or barium chloride solution turns turbid on passing gas evolved by acidification of carbonates but the solution becomes clear on prolonged passage of gas. 5

7. (a) Which Characterstics of cis platin makes it an effective antitumour drug ? Explain. 5

(b) Why is it necessary to test Group V ions in the order : Ba^{2+}, Sr^{2+}, Ca^{2+} ? Explain. 5

(c) Why is it necessary to remove interfering ions before Group III analysis ? Explain. 5

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(14)

[This question paper contains 8 printed pages]

Your Roll No. : .....

2019

Sl. No. of Q. Paper : **2205** **IC**

Unique Paper Code : 32171602

Name of the Course : **B.Sc. (Hons.) Chemistry**

Name of the Paper : Organic Chemistry - V

Semester : VI

Time : 3 Hours ***Maximum Marks : 75***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Attempt any **six** questions.

(c) Question **NO.1** carries **15** marks.

1. Answer any **five** parts : 5×3=15

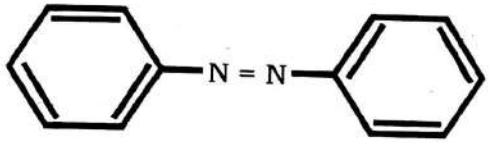
(a) Write the open chain structure for the aldaric acid obtained by the nitric acid oxidation of D(+)–Glucose. Is the product optically active ? Explain with the help of structures.

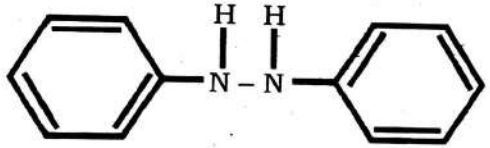
(b) Write the structure and common name of 4–O–β–D–galactopyranosyl–β–D–(+)–glucopyranose.

(c) Write down the possible isomers of $C_2H_2Cl_2$ and distinguish them using IR spectroscopy.

P.T.O.

(d) Which one of the following will absorb at higher wavelength ($\lambda_{max.}$) and why ?

(i) 

(ii) 

(e) Define diblock polymers giving suitable examples.

(f) What is a leuco base ? How can it be converted into a dye ?

(g) How many types of chemically equivalent protons are there in $ClCH_2CH_2CH_2OH$? Give reasons.

2. An organic compound **A** having molecular formulae $C_5H_8O_3$, shows the following data :

NMR

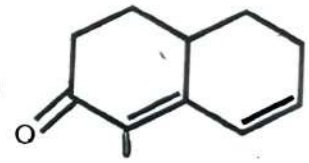
δ values	Intensity	Multiplicity
2.2	3	singlet
2.4	2	triplet
2.7	2	triplet
11.1	1	singlet

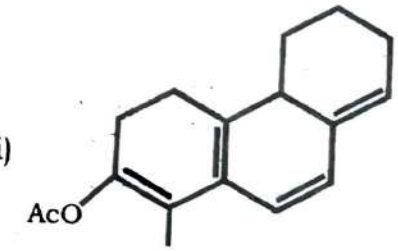
IR : 1715 & 1740cm^{-1}, 2950 cm^{-1} 3030cm^{-1} 3500-2500 cm^{-1}, no doublet between 2720 & 2820 cm^{-1}

UV λ_{max} 283nm(ε-25)

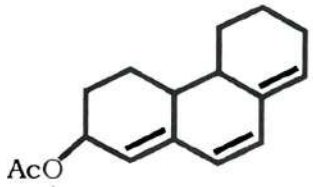
Compound **A,** does not reduce Fehling's solution but gives effervescence with sodium bicarbonate. Calculate the double bond equivalents for **A** , Deduce the structure of A and explain the entire spectral data. 12

3. (a) Calculate the λ_{max} values for the following compounds (any **three**) : 3×2=6

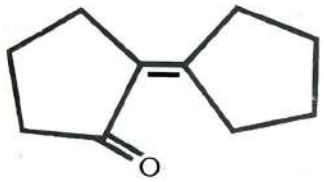
(i) 

(ii) 

(iii)



(iv)



Values for calculations :

Heteroannular diene : 214 nm

Acyclic/cyclic six membered α,β-unsaturated ketone : 215 nm

Five membered Cyclic á,.....-unsaturated ketone : 205 nm

Homoannular diene : 253 nm

Alkyl group/ exocyclic double bond : 5 nm

Extended conjugation : 30 nm

3×2=6

(b) How will you distinguish between the following pairs of compounds using IR spectra ? Give reasons. 3×2=6

(i) Propanal and Propanol

(ii) Salicylic acid and p-hydroxybenzoic acid.

4. (a) Differentiate between the following pairs of compounds using UV spectroscopy. 4

(i) Cis and trans- stilbene

(ii) Acetone and methylvinylketone

(b) A compound A having molecular formulae C_3H_6O, gave the following spectral data :

(i) UV λ_{max} 292nm ε 21.

(ii) IR 2720 & 2820cm^{-1}(doublet) and 1730cm^{-1}.Deduce the structure of the compound A and explain the spectral data.

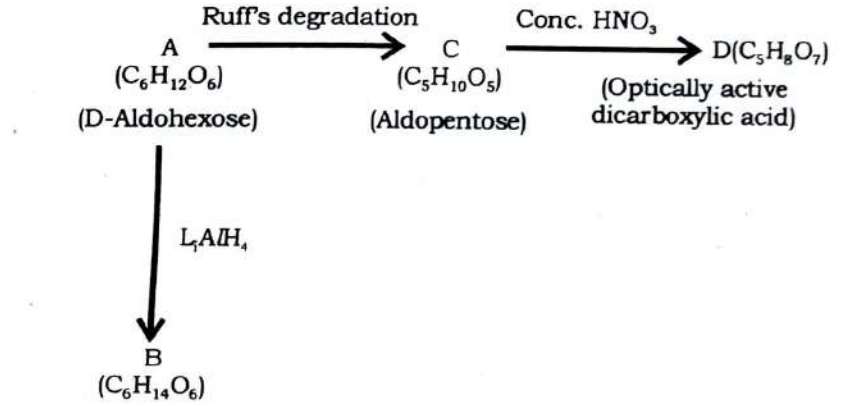
(c) Explain Anisotropic effect and state why acetylenic protons absorb at lower δ value as compared to ethylinic protons in NMR spectra. 4,4,4

5. (a) Explain why α-D(+)-glucopyranose is less stable than β-D(+)-glucopyranose whereas, methyl α-D(+)-glucopyranoside is more stable than its corresponding β-anomer. 4

(b) Draw the Fischer projection formulae for the hemiacetal form of **C-2-epimer** of D(+)-Glucose. Convert the drawn Fischer projection formulae to Haworth Projection formulae and show how many Walden inversions are involved during this conversion ? 4

(c) Sucrose can be considered both as a glucoside and a fructoside. Draw its structure and give the systematic names of both glucoside and fructoside. 4

6. (a)



Assuming all sugars belong to D-series, deduce the structures of **A, B, C, D** and write all the reactions. 4

(b) Explain why D–(+)–Glucose and D–(–)–Fructose form the same osazone on reaction with excess of phenyl hydrazine. Write the chemical reaction with any **one** of the above. 4

(c) Fehling's solution is a well-known oxidizing agent for confirming the presence of aliphatic aldehydic group. Explain with the help of reactions, why D(-)-Fructose inspite of having a ketonic group is oxidized by Fehling's solution. 4

7. (a) Differentiate between Thermoplastics and Thermosetting polymers giving suitable examples. 4

(b) What do you understand by the terms- Syndiotactic , Isotactic and Atactic polymers ? Explain taking polypropylene as an example. 4

(c) Give the mechanism for acid catalysed formation of phenol-formaldehyde resin. 4

8. (a) How will you synthesize Alizarin from Anthraquinone ? 4

(b) How will you distinguish between Methyl orange and Malachite green based on the following : 4

(i) Classification

(ii) Structure

(iii) Uses (any one for each dye)

(c) Phenolphthalein is colourless in acidic medium, deep pink in alkaline medium but again colourless in strongly alkaline solution. Explain. 4

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15

[This question paper contains 6 printed pages.]

Your Roll No.....

2019

Sr. No. of Question Paper : 2471 **IC**

Unique Paper Code : 42177919 / 32177903

Name of the Paper : Applications of Computer in Chemistry

Name of the Course : **B.Sc. (Program) / B.Sc. (Hons.) : DSE-1B/3**

Semester : VI

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **All** the questions are compulsory.

1. Answer all parts of the question :

(a) Define the following :

(i) Software

(ii) Algorithm

(iii) Operating System

(b) Write the expanded form of the following :

(i) QBASIC

P.T.O.

(ii) ROM

(iii) CPU

(c) What is a byte? Complete the following statement :

____ Giga Byte = ____ Tera Byte

(d) Write the following in BASIC :

(i) $Y = 56R^2 T^4 / 6.6 \times 10^{-34} P$

(ii) $p = A(1+r)^n/[q^r - 1]$

(iii) 0.00008532

(e) Convert the following :

(i) $(1100101)_2$ binary to decimal

(ii) $(567.125)_{10}$ decimal to binary (3,3,2,3,4)

2. (a) Identify the errors in the following constants :

(i) 0.6351-E14

(ii) 453R7

(iii) "MO-Theory"

(iv) "X+Y"

(b) Identify the error in the following variables :

(i) CLS

(ii) 4temp

(iii) End

(iv) K$val

(c) Write a program in BASIC to construct and multiply two 3X3 matrix, using READ....DATA statement. (4,4,4)

3. (a) Identify the error in the following :

(i) For A(I) = 1 to N Step 5

(ii) PSET (X-Y)

(iii) If P=30 then M$=55

(iv) For I = 1 to 10 Step x

Next x

(v) DEF FN7(X) = X^2 - 5

(vi) Locate (45,60)

(b) Write the output of the following :

(i) Print "Name", "Roll Number", "Marks"

Print

Print N$, R1, M2

Print A+B*C, N$, A/C

Where N$ = Peter, R1=60, M2=359, A=15, B=2, C=3

(ii) 10 SCREEN 1

20 WINDOW (0,0) - (50,50)

30 PSET (30, 40)

40 LINE (0,0) - (10,10)

50 END (6,6)

4. (a) Write the BASIC statement to produce the following effects :

(i) 1-D array to hold 50 items of data.

(ii) Assign the value 35 to a variable PI.

(iii) Assign a string MAXWELL DISTRIBUTION to the variable.

(iv) If P has a value greater than 150, then transfer control to the statement number 70, otherwise execute the next statement.

(b) Differentiate between the following :

(i) Low level Language and High Level Language

(ii) Screen 1 and Screen 2

(iii) RAM and ROM

(c) What is the use of REM statement? (4,6,2)

5. (a) Write a program in BASIC to calculate the following :

$$u_{av} = \sqrt{\frac{8RT}{\pi M}} \text{ and } u_{rms} = \sqrt{\frac{2RT}{M}}$$

For various gases, R = 8.314, T = 350, M = 32×10^{-4}

(b) Identify the errors in the following, if any :

(i) 10 For J=1 to N

---

30 For K= 1 to M

---

70 Next J

80 Next K

(ii) 20 FOR N = 1 TO 100

---

70 ---

90 NEXT N

---

120 IF N = 10 THEN 70

(c) Write a program to draw a filled rectangle box with diagonal coordinates (50, 65) and (120, 160) in high resolution mode. (4,4,4)

6. (a) Explain the function of the following keywords :

(i) LET

(ii) PSET

(iii) GOSUB

(iv) DIM

(b) Write a program in BASIC to find the value of Mean, Variance and Standard Deviation of a set of N numbers. Provide the data using Input statement.

Mean = $1/N \ \Sigma Xi$

Variance = $1/N \ \Sigma(Xi - \bar{X})^2$

Standard Deviation = (Variance)^1/2

OR

(b) Write a program in BASIC to find the root of following equation using Iterative Method or Newton Raphson Method :

$$X^5 - 6x^2 + 8 = 0$$

(c) Mention any three applications of computer in Chemistry. (4,5,3)

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16

This question paper contains **4** printed pages]

Roll No. | | | | | | | | | | | |

2019

S. No. of Question Paper : **2526**

Unique Paper Code : **32177909/42177918** **IC**

Name of the Paper : **Industrial Chemicals and Environment**

Name of the Course : **B.Sc. (Hons.) Chemistry/**

B.Sc. (Prog.) : DSE-3/1B

Semester : **VI**

Duration : **3 Hours** Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *five* questions in all.

All questions carry **15** marks each.

Question No. **1** is compulsory.

1. (*a*) Fill in the blanks (any *five*) :

(*i*) London smog is ------ smog.

(*ii*) ------- may be applied as a coagulant for treatment of water.

(*iii*) Nitrogen gas is mostly used for ------.

(*iv*) In a nuclear reactor ------- are used to control the high energy neutrons.

(*v*) -------- is used to remove particulate matter from flue gases.

(*vi*) --------is a renewable energy source.

(*b*) Define the following with suitable examples or reactions (any *five*) :

(*i*) Ozone hole

(*ii*) Biocatalyst

(*iii*) Liebig's law of minimum

(*iv*) Green Chemistry

(*v*) Biosphere

(*vi*) Dry adiabatic lapse rate.

(*c*) Draw a labelled diagram of hydrological cycle. Indicate at what levels and how water pollution affects this cycle. 5,5,5

2. (*a*) How is bleaching powder manufactured ? What are its main applications ? How does bleaching powder disinfect water ?

(*b*) How is iron extracted from pyrites ? Give stepwise procedure ?

(*c*) "Biological treatment of water is carried out during secondary treatment process." Justify.

(*d*) Explain with reactions "Oxygen plays an important role in troposphere while ozone plays a key role in stratosphere". 5,4,3,3

3. (*a*) What are the major sources and sinks of SO_2 in atmosphere ? Discuss a method of estimating SO_2 in an air sample.

(*b*) Give different methods of liquefying gases.

(*c*) Describe a process of converting low grade coal into an energy efficient fuel.

(*d*) How do CO_2 and H_2O vapours act as greenhouse gases ? 5,4,3,3

4. (*a*) With reactions explain how chlorofluorocarbons deplete ozone ? Give the safer substitutes of chlorofluoro-carbons. How are they safer ?

(*b*) List the pollutants present in the effluents of fertilizer and petrochemical industries. Suggest a method for treatment of the same.

(*c*) Draw a labelled diagram of biogeochemical cycle of Nitrogen.

(*d*) What are the advantages and disadvantages of geothermal energy ? How can it be harnessed ? 5,4,3,3

5. (*a*) Derive the expression $L_t = L_0 e^{-kt}$ for BOD calculations. Define each term involved.

(*b*) What is photochemical smog ? How do the oxidants present in the smog affect living organisms ?

(*c*) Describe a case of nuclear disaster and its consequences.

(*d*) Differentiate between BOD and COD. Which will be higher for surface waters and why ? 5,4,3,3

6. Write short notes on any *three* of the following :

(*a*) Bhopal gas disaster

(*b*) Safe disposal of nuclear waste

(c) Ion exchange resins and their application to water treatment

(d) Manufacture and use of borax. 3×5

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17

This question paper contains 4+2 printed pages]

Roll No. | | | | | | | | | | |

2019

S. No. of Question Paper : **8884**

Unique Paper Code : **32177904** **HC**

Name of the Paper : **Analytical Methods in Chemistry**

Name of the Course : **B.Sc. (H) Chemistry/B.Sc. (Prog.)**

DSE-3B

Semester : **VI**

Duration : **3 Hours** Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Log tables to be provided to the candidates.

Use of scientific calculator is allowed.

Attempt any *six* questions in all including

Q. No. **1** which is compulsory.

1. Attempt any *five* of the following : 5×3=15

(*a*) Explain the types of interferences generally produced in atomic absorption spectroscopy (AAS).

(*b*) Discuss the various equilibrium processes involved in the solvent extraction of metal ions by solvation.

P.T.O.

(*c*) What is the object of sampling in an analysis ? Explain the procedure of obtaining a representative sample of solids.

(*d*) State Beer's law. What are the factors responsible for the deviation of this law ?

(*e*) Discuss redox potentiometric titration with the help of a suitable example.

(*f*) Explain the basic principle involved in thermogravimetric analysis.

2. (*a*) Describe analytical applications of Thermogravimetry. Draw a labelled diagram of thermobalance and describe its major components.

(*b*) Derive the following :

$$M_n = M\left[\frac{V}{DS + V}\right]^n$$

Where V mL of the aqueous solution containing M *g* of the solute is extracted with S mL of the organic solvent. M_n *g* solute remains in the aqueous layer after the *n*th extraction. D is the distribution ratio.

(*c*) Does a large K_D means a high or low retention of the solute to an ion exchange resin ? Justify your answer. 3×4=12

3. Write short notes on any *three* of the following :

(*a*) Significant figures and propagation of error

(*b*) Column efficiency

(*c*) Electroanalytical methods

(*d*) Monochromators. 3×4=12

4. (*a*) Discuss frontal and elution methods of development of chromatograms.

(*b*) Explain the various processes involved in flame emission spectroscopy (FES). Discuss choice of flame and burner designs used in AAS and FES.

(*c*) The absorbance of a 0.0001M solution of a complex is found to be 0.312 at 592 nm. What is the molar absorptivity if the path length is 1.0 cm ? 3×4=12

5. (*a*) What are the various oxidants used in AAS ? How does the combination of fuel gases and oxidants affect flame-temperature ?

(*b*) What are the various ways of expressing accuracy and precision ?

(*c*) Suggest the effect on plate height (H) if each of the following changes were incorporated into a column chromatographic experiment :

(*i*) An increase in flow rate

(*ii*) An increase in the diameter of the column

(*iii*) An increase in the column length

(*iv*) An increase in the temperature of the column. 3×4=12

6. Distinguish between the following :

(*a*) Determinate and indeterminate errors.

(*b*) Partition chromatography and adsorption chromatography.

(*c*) Differential thermal analysis (DTA) and differential scanning calorimetry (DSC). 3×4=12

7. (*a*) What do you mean by a mobile phase and a stationery phase in a chromatographic technique ? Explain with an example.

(*b*) The accuracy of a new method for analysis of Fe(III) is compared with the standard method. The results of % Fe(III) for each analysis are as follow :

New Method	Standard Method
20.10	18.89
20.50	19.20
18.65	19.00
19.25	19.70
19.99	19.40
19.40	

Is there a significant difference between the two methods ?

(The tabulated value of F and *t* are 6.26 and 2.262 respectively at 95% of confidence level).

(*c*) Give a schematic diagram of a glass electrode and explain its function. Why is the glass electrode stored in water ? 3×4=12

8. (*a*) Define the following terms and give the mathematical expression for each of the following :

(*i*) Retardation factor

(*ii*) Partition coefficient.

(*b*) A solution containing 0.804 mg of solute per 100 mL of solvent gives a 40% transmittance in a 1 cm cell.

(*i*) What is absorbance of solution ?

(*ii*) What would be the absorbance and %T be if the solute was reduced to 0.402 mg of solute per 100 mL of solvent ?

(*c*) 184 mg of a sample of mixture of $MgCO_3$ and $CaCO_3$ is reduced to 160 mg when subjected to thermogravimetric analysis in the temperature range 480°C-640°C. Calculate the amounts of Mg and Ca in the sample. 4×3=12

Sl-no- of Q.P : 3570 (18) 2019

Unique Paper Code	:	217601
Name of paper	:	Inorganic Chemistry –V (CHHT-615)
Name of the Course	:	B.Sc. (Hons) Chemistry
Semester	:	VI
Duration	:	3 Hours

Maximum Marks: 75

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Instructions to candidates:

Attempt any Five questions.

1 (a) Account for the following:

(i) Lead sulphate dissolves in ammonium acetate.

(ii) The Group II centrifugate is boiled with few drops of concentrated HNO_3 before proceeding for Group III.

(b) Highlight the differences between hemoglobin and myoglobin. What is Bohr effect?

(c) With reference to the molecular orbital diagram of carbon monoxide, explain the following:

(i) The bonding in metal carbonyls is through C and not through O.

(ii) The IR stretching frequency for C- O bond in CO(g) is higher than that in metal carbonyls.

(iii) The IR stretching frequency for C- O bond in metal carbonyls decreases with increasing negative oxidation state of the metal atom.

(4,5,6)

2 (a) Using VBT explain the structure of $[Fe(CO)_5]$. Are all the Fe-C bond lengths identical in this compound?

(b) What is common ion effect? How is this effect utilized in separation of Group II cations from Group IV cations?

(c) What is the purpose of the sodium potassium- pump in the human body? Describe the working of the pump with a self-explanatory diagram and mention the evidences pointing to the nature of the respective ion channels that make the process selective.

(4,5,6)

3 (a) Mention any two features that a chelating agent should possess to be used in medicine. Give two examples of such drugs.

(b) Give the Friedel Craft's acylation reaction of ferrocene. When treated with excess acylating agent ferrocene gives the 1,1' diacyl derivative but on alkylation it gives the 1,2 dialkyl derivative. Explain.

(c) A metal 'M' exists in two oxidation states +1 and +2. The sulphide 'MS' is insoluble in dilute hydrochloric acid and is black in colour. When a solution of potassium iodide is added to an aqueous solution containing M^{2+}, a red precipitate is obtained which dissolves in excess of potassium iodide to give a compound 'A' which is an important laboratory reagent. Addition of tin (II) chloride to a solution of M^{2+} gives a white precipitate turning grey. Using the information provided identify 'M' and 'A'. Explain by giving equations. Also state one use of 'A'.

(4,5,6)

4 (a) What are the toxic effects of arsenic **or** mercury?

(b) Carbonate does not interfere in the test for sulphite , but sulphite interferes in the test for carbonate. Explain.

(c) Give the mechanism of action of cis-platin in cancer therapy. What is meant by Therapeutic Index?

(d) How are organometallic compounds classified based on bond types? Give an example in each case.

(2,3,5,5)

5 (a) Why do interfering radicals interfere after Group II? How will you remove phosphate **or** oxalate?

(b) What is meant by the cooperativity of the four heme groups in hemoglobin? What acts as the trigger for the cooperative effect? Discuss briefly.

(c) Using 18 electron rule as a guide, identify/find:

(i) The 3d metal in $[(\eta^5\text{-}C_5H_5)M(C_2H_4)_2]$

(ii) The probable number of carbonyl ligands in $[HMn(CO)_n]$

(iii) The number of Co-Co bonds in $[Co_4(CO)_{12}]$

(4,5,6)

6 (a) The V-C bond lengths in $[V(CO)_6]$ and $[V(CO)_6]^-$ are 200 pm and 193 pm respectively. Explain.

(b) What is the difference between active and passive transport?

(c) What is the chemistry of the chromyl chloride test? What are the limitations of this test?

(d) Zn^{2+} is considered as one of the most versatile catalysts in the bio system. Elaborate. What is the coordination number and environment of Zn^{2+} in carbonic anhydrase?

(3,3,4.5)

7 (a) Why do cations of Group V in the qualitative analysis impart colour to the flame?

(b) Why is it necessary to neutralize the sodium carbonate extract prior to carrying out confirmatory tests of anions?

(c) How and in what form is iron stored in human body? How is iron recycled in the human system?

(d) Give one method of preparation of ferrocene. Why is it aromatic? Give two evidences which support its aromatic nature.

(2,3.5,5)

Sl. No. of Q.P. 3571 (19)

2019

Unique Paper Code	:	217603
Name of the Paper	:	Organic Chemistry V (CHHT-616)
Name of the Course	:	B.Sc. (Hons.) CHEMISTRY, ~~Part III~~ I
Semester	:	VI
Duration	:	3 Hours
Maximum	:	75

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Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt on this question paper.
2. Answer any **six** questions in all.
3. Question No. **1** carries 15 Marks.

Q1. Answer any five parts.

(a) Give the number of NMR signals in each of the following compounds. Label different types of protons.

(i) 2- Chloropropene
(ii) Allylbromide

(b) How will you distinguish between the following pairs of compounds using IR spectroscopy? Describe the approximate characteristic absorption frequencies also.

(i) 2- Propanol and acetone
(ii) Primary and secondary amine

(c) The UV spectrum of acetone shows peaks at –
λ_{max}=280 nm, ε_{max} =15 ; λ_{max}=190 nm, ε_{max} = 900

(i) Identify the electronic transition for each.
(ii) Which is more intense?

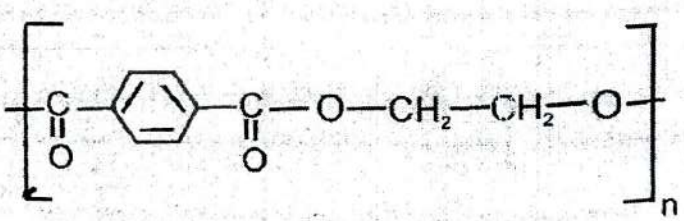
(d) What type of polymerisation (mechanism) is initiated by the following catalysts?
(i) KNH_2 (ii) H_2SO_4

(e) (A)+ N,N-Dimethylaniline $\xrightarrow[0°C]{\text{Aceticacid}}$ (B) $\xrightarrow{\text{Alkaline medium}}$ (C)Methyl orange

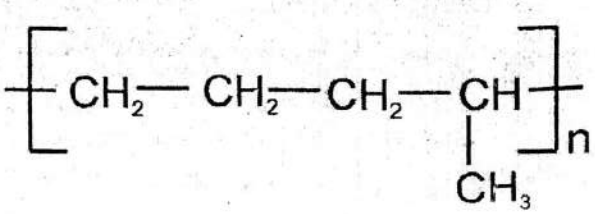
C at pH <3.1 gives red colour and at pH 4.4 gives yellow colour. Give the structure of A, B, and C.

(f) Write the structures of monomers of following polymers.

(i)

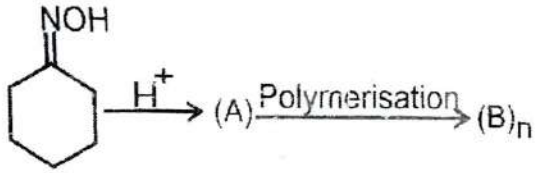


(ii)



(3 x5)

Q2. (a) Identify products (A) and (B) in the following sequence of reactions. Write their structures also.



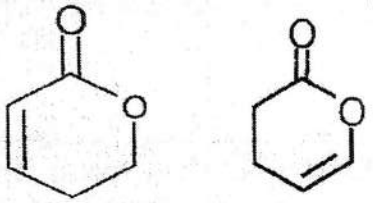
(b) Low density polythene is obtained by free radical polymerisation. Why is the density low? Explain through mechanism.

(c) A Polymer sample contains only two types of macromolecules. Those with relative molar mass (RMM) of 10,000 and those with an RMM of 100,000. Assuming equal number (N) of molecules, calculate $\overline{M}_n$ and $\overline{M}_w$. (4×3)

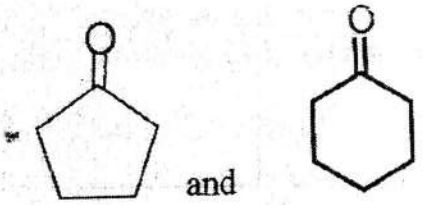
Q3. (a) Calculate the wave number of fundamental stretching vibrations of C=C bond. Force constant for C=C bond is 10×10^5 dynes /cm and Reduced mass is $6\times1.67\times10^{-24}$ g

(b) An amide, chloracetamide, shows two peaks at 1644 cm^{-1} and1615 cm^{-1}. Identify to which functional group these vibrations belong.

(c) Match the C=O stretching vibrations for following compounds .



(1720, 1760 cm^{-1})



and

(1745,1715cm^{-1})

(4×3)

Q4. (a) (i) calculate the magnetic field that corresponds to proton resonance frequency of 60 MHz.

Gyromagnetic ratio for proton, $\gamma = 26753 sec^{-1}\ gauss^{-1}$.

(ii) Which of the following systems will have spin-spin interaction between proton and other atom.

$N^{14}-H$; $O^{16}-H$

(b) A compound with molecular formula $C_5H_{12}O$ shows the following absorptions in NMR

δ 0.9(3H,t);1.2(6H,s);1.5(2H,q),1.64(1H,broad singlet)

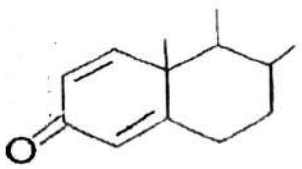
(i) Calculate double bond equivalent

(ii) Propose the structure and assign all peaks.

(c) Account for the fact that an aromatic hydrogen absorbs relatively down field (7- 8.5 ppm).

(4×3)

Q5. (a) Calculate λ_{max} for the following enone



Parent enone 215nm
Extended conjugation is = +30nm
Homoannular component = +39 nm
Exocyclic double bond = +5nm
Alkyl α =+10, β = +12, γ and higher = +18 nm

(b) Predict and explain the λ_{max} shift when
(i) $ArNH_2$ is acidified.
(ii) ArOH is made basic

(c) (i) Differentiate between following two compounds by UV
(a) CH_3COOCH_3
(b) $C_6H_5CH = CHCOOCH_3$.
(ii) Differentiate between auxochrome and chromophore with example.

(4×3)

Q6. An acyclic compound $C_6H_{12}O_2$ has strong bands at 1740 cm^{-1}, 1250 cm^{-1}, 1060 cm^{-1} with no bands at frequency greater than 2950 cm^{-1}.
The NMR spectrum has two singlets at δ 3.4(3H) and δ 1.0(9H).Calculate double bond equivalent .Deduce the structure of compound . Explain all the peaks.

(12)

Q7. (a) (i) Given green, blue and yellow dyes. Arrange them in order of increasing wave length of absorption.
(ii) Give one synthesis of Congo Red

(b) Give one synthesis of Malachite Green
(c) Give one synthesis of Alizarin from Anthraquinone

(4×3)

Q8. Write short notes on
(a) Anionic polymerisation of acrylonitrile with mechanism.
(b) Sulphur vulcanisation of rubber.
(c) Mechanism of diazocoupling with necessary conditions.

(4×3)

(20)

2019

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I

SET A

S.No of Question Paper : 3572

Unique Paper Code : **217605**

Name of the Course : **B.Sc (H) Chemistry**

Name of the Paper : **Physical Chemistry V (CHHT- 617)**

Semester : **VI**

Duration: **3 hours** Maximum Marks: **75**

Attempt six questions in all.
Question No.1 is compulsory.
Attempt at least two questions from each section A and section B.
Scientific calculators are allowed but they cannot be shared. Use of Log tables is allowed

Physical Constants
Plancks constant, $h = 6.626 \times 10^{-34}$ Js
Velocity of light, $c = 3 \times 10^{8}$ ms^{-1}

1. Answer any **five** (5 x 3=15)

a. What are the quantum numbers and degeneracy of the quantum level of energy $E = 27h^2/8ml^2$ for a particle in a cubic box of length 'l'?

b. Selection rule for pure rotational spectra in microwave region is $\Delta J = +1$ or -1 whereas for rotational Raman spectra it is $\Delta J = 0, +2$ or -2. Give reasons.

c. Explain the difference between internal conversion and intersystem crossing.

d. Define Hermitian operator. Give one example.

e. What is meant by a well – behaved wave function?

f. Explain why the $^{12}_{6}C$ nucleus does not give rise to an NMR peak whereas $^{13}_{6}C$ nucleus does.

g. What are orthonormal set of wave functions?

h. Explain what are Rayleigh, Stokes and anti Stokes Lines.

Section A

2. a) Compare the VB and MO treatments of the hydrogen molecule in the ground state. (4)

b) What do you understand by i) Bonding ii) antibonding and iii) non-bonding orbitals. (3)

c) State Variation theorem. (2)

d) What are symmetric and anti symmetric wave functions. Which of the following are symmetric and which are ant symmetric.

i) $\Psi = \text{Cos}\theta$

ii) $\Psi = x(1+x)$ (3)

3. a) Write the unnormalised valence bond function for HF molecule for its ground state being formed from the ls orbital of H atom and the 2 p_x orbital of the fluorine atom. Assume that HF is: i) Pure covalent ii) Pure ionic iii) 80% Covalent and 20% ionic. (4)

b) What is the total energy operator? Write the total energy operator for rigid rotator. (3)

c) What is the essential criterion for the atomic orbitals to overlap. Write (Yes or no) whether the following orbitals will overlap or not. A and B are the two atoms bonding along the z-axis.
i) ls (A) and 2s (B) ii) 2 p_x(A) and 2p_y(B) (5)

4. a) Draw the MO diagram of O_2 molecule. Using this discuss the magnetic character of O_2^+, O_2^- and O_2^{2-}. (5)

b) For a particle of mass m in a one dimensional box of length 'l' having wave function

$$\Psi = (2/l)^{1/2} \text{ Sin } n\pi x/l$$

i) Calculate the expectation value of the total energy of the particle. (3)

ii) What is the zero- point energy of this particle? (2)

c) What is a quantum mechanical operator? Give an example. (2)

5. a) For BeH_2, construct qualitatively the expressions and shapes of molecular orbitals under the LCAO scheme. Draw the energy diagram and electronic configuration of the molecule. (5)

b) Determine the energy required for a transition from ground state to $n_x = n_y = 1$ and $n_z = 2$ state for an Argon atom (mass $= 6.633 \times 10^{-26}$ kg) in a cubic container with a 1.0 cm side. (3)

c) Show that e^{ax} is an eigen function of $(d^2/dx^2 + 2\, d/dx + 3)$. What is the eigenvalue? (4)

SECTION B

6a) Derive the expression, $J_{max} = (kT / 2Bhc)^{1/2} - (1/2)$

What do J_{max} and B represent? (4)

b) What are hot bands? Why do intensities of hot bands of diatomic molecules increase with rise in temperature? (4)

c) For a molecule AB_2 the following spectroscopic data is observed. Predict the geometry of the molecule and assign the wave numbers of specific vibrations

ν (cm^{-1})	IR	Raman
1330	Inactive	Active
2349	Active PR	Inactive
667	Active PQR	Inactive

(4)

7. a) Calculate the force constant for ^{13}CO where fundamental vibrational frequency is 2990 cm^{-1} and reduced mass is 1.62 $X10^{-27}$kg. (3)

b) What is meant by vertical transitions in electronic spectra? Outline the spectra obtained under the following conditions: [show diagrams also]

i) The internuclear distance is equal in the upper and lower electronic states.

ii) The internuclear distance is slightly longer in the upper electronic states.

iii) The internuclear distance is considerably longer in the upper electronic states. (7)

c) The first two lines in rotational spectra of $^{12}C\ ^{16}O$ appear at $1.15X10^5$ and $2.30 X 10^5$ MHz respectively. Calculate the rotational constant for CO. (2)

8a) Sketch the NMR spectra of ethanol under

i) Low resolution
ii) High resolution

Clearly indicate the relative positions of the peaks. Also give the ratio of peak area in (i) and relative intensities of the split peaks in (ii). (6)

b) Explain ESR signals are recorded as derivative of absorption curve with respect to the magnetic field. (2)

c) Which reference compound is used in NMR studies in case of aqueous solutions? Give reasons why it is used. (4)

9. Write short notes on any **Three** : (3 x 4 = 12)

a) Dissociation and Pre dissociation

b) Fluorescence

c) Chemical Shift and Coupling Constant

d) Factors responsible for the intensity of Spectral lines

e) Fingerprint region and Group frequencies in IR

Sl. No of Q.P. 4021

(21)

Roll No.....

1115
2019

Unique Paper Code	:	2171601
Name of Course	:	B.Sc. (H) Chemistry
Semester	:	VI
Name of the Paper	:	Inorganic Chemistry: Organometallic, Bioinorganic Chemistry
Duration	:	3 Hours
Maximum Marks	:	75

F-12

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Instructions for the Candidates

1. Attempt any five questions.
2. All questions carry equal marks.

1. a) What are the metal ions present in the biological systems? Classify them into essential and non-essential.
   b) Which out of the following is a poor nucleophile and why?
   $Co(CO)^-$, $Mn(CO)_5^-$
   c) Discuss two methods of preparation of organometallic compounds with π acceptor ligand CO.
   d) What is synergic effect, explain using the molecular orbital diagram of CO ligand.

(3,3,4,5)

2. a) What is Ziese's salt? Write its chemical formula and draw its molecular structure.
   b) Why is direct nitration of ferrocene not possible?
   c) Draw the structure of the following metal carbonyls
   (i) $Fe_3(CO)_{12}$ (ii) $Cr(CO)_6$ (iii) $Mn_2(CO)_{10}$ (iv) $Ru_3(CO)_{12}$
   d) What are homoleptic carbonyls? Why don't carbonyls belonging to early and later transition series obey the EAN rule?

(3,3,4,5)

3. a) Draw the structure of ferrocene. What are its two possible conformations? Is it an organometallic compound? Discuss its synthesis.
   b) What are toxic metals and why are they so?
   c) Discuss the Na^+/K^+ pump with a diagram
   d) What is Ziegler - Natta catalyst ? Explain isotactic polymerization of ethane.

(3,3,4,5)

4. a) Why Ferrocene is more reactive than benzene ? Give two reactions.
   b) Which of the following obey the EAN rule:
   $Cr(CO)_6$, $(\eta5\text{-}C_5H_5)Fe(CO)_2Cl$, $V(CO)_6$, $Fe(CO)_5$
   c) Two different structures of $Co_2(CO)_8$ are consistent with18 electron rule . How will you predict the structures on the basis of IR spectral studies?
   d) Explain the pathways for inactivation of hemoglobin.

(4,4,4,3)

5. a) Explain the tetrameric structure of the hemoglobin, how does it work ?

   b) Arrange following given metallocene in order of increasing M-C bond distance:

   $[(\eta^5\text{-}C_5H_5)_2Fe]$, $[(\eta^5\text{-}C_5H_5)_2Co]$, $(\eta^5\text{–}C_5H_5)_2Ni$, $(\eta^5\text{-}C_5H_5)_2V$.

   c) Which are paramagnetic metallocene(s) in following:

P.T.O.

$[(\eta^5\text{-}C_5H_5)_2Fe]$, $[(\eta^5\text{-}C_5H_5)_2Fe]^+$, $[(\eta^5\text{-}C_5H_5)_2Co]$, $[(\eta^5\text{-}C_5H_5)_2Co]^+$, $[(\eta^5\text{-}C_5H_5)_2Ni$

d) Why is $Ni(CO)_4$ a monomer, but the analogous cobalt compound a dimer?

(4,4,4,3)

6. a) What would have happened if the ATPase involved in the sodium-potassium pump did not undergo eversion?
   b) What will happen when excess of Copper and Lead metals ions present in human body ?
   c) What is meant by the term hapticity. Explain with example.
   d) What do you understand by common ion effect? Explain with example.

(4,4,3,4)

7. a) What are interfering anions? Write a method of removal of any one interfering radicals.
   b) Write use of following reagents in the qualitative analysis:
   (i) Dimethylglyoxime (ii) Sodium nitropruside

c) Why is Pb^{2+} frequently missed in Group I and Cd^{2+} in Group II, particularly if the medium is highly acidic with respect to HCl.

d) Write a confirmatory test for sulphate and Chloride.

(3,3,5,4)

(22)

Sl-No. 09.P: 4022

2019

Unique Paper Code : 2171602

Name of the Paper : Theory Physical- Quantum Chemistry, Photochemistry & Surface Chemistry

Name of the Course : **B.Sc. (H) Chemistry**

Semester : VI

Duration : 3 hours

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F-12

Maximum Marks: 75 Marks

Instructions for Candidates

1. Write your roll no. on the top immediately on receipt of this question paper.
2. Attempt only **six** questions out of **eight**.
3. **Question No. 1** is compulsory.
4. Use of scientific calculators and logarithmic tables is allowed.
5. Attempt all parts of a question together.

Physical Constants

Planck's constant	6.626×10^{-34} Js
Velocity of light	3.0×10^{8} m s^{-1}
Avogadro's Number	6.023×10^{23} mol^{-1}
Mass of electron	9.1×10^{-31} kg
Boltzzmann constant	1.38×10^{-23} J K^{-1}

1. Attempt ***any five:***

(a) What important aspect is signified for an atomic model with a particle in free space and under bound state?

(b) Differentiate between thermal reactions and photochemical reactions.

(c) State and explain Pauli's exclusion principle.

(d) Explain why most adsorption processes are exothermic in nature?

(e) Fluorescence is a fast process whereas phosphorescence is a slow process. Explain.

(f) Why a finely powdered substance is more effective adsorbent?

(g) Comment on the statement "Quantum efficiency of a primary process is always equal to one".

(3×5)

2. (a) A particle of mass m is confined to a three dimensional box of length a, width b, and height c, the potential energy of the particle varies as under:

$$V=0 \text{ for } \begin{Bmatrix} 0 \le x \le a \\ 0 \le y \le b \\ 0 \le z \le c \end{Bmatrix}$$

$V = \infty$ elsewhere

Formulate the Schrödinger wave equation for the system.

(b) Write energy expression for a particle of mass 'm' confined to move in a one-dimensional box of length 'l'. Calculate the energy required for a particle of mass 1.0×10^{-30} kg to move from energy level 3 to 4, the length of the box is 973 pm.

(c) Prove Heisenberg uncertainty principle mathematically.

(4.4.4)

3. (a) Show that the function $\psi = x \exp(-bx^2)$ is an eigen function of the operator $\left(\frac{d^2}{dx^2} - 4b^2x^2\right)$. What is the eigen value?

(b) Calculate the expectation value of momentum of a particle described by the function e^{-ikx} where x can extend from 0 to 1.

(c) Benzene may be taken as a two-dimensional box of side 0.4 nm. Compute the wavelength of radiation that can cause promotion of an electron from the ground to the first excited state of benzene.

(4.4.4)

4. (a) Compare Valence Bond and Molecular Orbital treatments of the hydrogen molecule in the ground state.

(b) Normalize the following functions in the interval 0 to ∞

[i] e^{-5x}

[ii] e^{-bx} (where b is a constant).

(c) Sketch R(r) and $4\pi^2r^2R^2(r)$ vs r/a_0 for 2s orbital of hydrogen atom. Calculate the number of nodes in this orbital.

(4,4,4)

5. (a) Determine if each of the following functions is acceptable or not as a wavefunction over the indicated regions

[i] Cos x over $(0,\infty)$

[ii] e^x over $(-\infty,\infty)$

[iii] e^{-x} over $(0,\infty)$

[iv] Tan θ over $(0,2\theta)$

(b) Calculate the zero point energy for a mass 1.68×10^{-27} kg executing simple harmonic motion given that the force constant k= 10 N m^{-1}.

(c) The average energy of H atom calculated on the basis of trial function $\psi = e^{-\alpha x}$ is $\langle E \rangle = \frac{h^2\alpha^2}{8\pi^2 m} - \frac{e^2\alpha}{4\pi\varepsilon_0}$

where α is a variable parameter. Using variation method, calculate the ground state energy of H atom.

(4,4,4)

6. (a) State and explain Stark- Einstein law of Photochemical Equivalence.

(b) **Quantum yields of photochemical reactions range from 0 to 10^5. Explain.**

(c) A certain substance in a cell of length 'l' absorbs 20% of the incident light. What fraction of the incident light will be absorbed in a cell which is six times as long?

(4,4,4)

7. (a) What is the effect of temperature on Physisorption and Chemisorption?

(b) The adsorption of gases on solids can be described by the Freundlich's empirical equation:

$(x/m)=kp^{1/n}$

Explain the terms involved. What should be the value of n and why?

(c) What are the assumptions of Langmuir adsorption theory? On the basis of Langmuir theory of adsorption, show that

$$\theta = Kp/(1+Kp)$$

(4,4

8. Write short notes on ***any three***:

(a) Fluorescence and Phosphorescence

(b) Photosensitised reactions

(c) Lambert Beer's law

(d) Born Oppenheimer Approximation

(e) Surface active agents

(4

S. No. Q.Paper: 4023 (23) 2019

Unique Paper Code: 2171603

Name of Paper: Chemistry of Inorganic Solids, Nanomaterials

Name of Course: B.Sc (H) Chemistry

Semester : VI

F-12

Duration: 1.5 Hours

Maximum Marks: 37.5

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Section A

Attempt any THREE questions in all. Question No. 1 is COMPULSORY and carries 7.5 marks

Q1.

a) What are one - dimensional control in carbon nanotubes?
b) What are Molecular Magnets? Explain with example.
c) What are the advantages of inorganic pigments?
d) Write the name of materials used in luminescent devices?

[2, 2, 2, 1.5]

Q2.

a) Write down the steps involved in the preparation of silver nanoparticles.
b) What are the requirements in terms of size, charge and structure lattice of the parent and the final compounds for the ion exchange synthesis?
c) How can we differentiate between nanotubes, nanowires and nanoparticles?

[5, 5, 5]

Q3.

a) Discuss the conventional heat and beat method for the synthesis of inorganic solids. What are the limitations of this solid state synthesis method?
b) How does the ion exchange and intercalation in solid state compounds lead to the modification of solid materials? Explain with examples.
c) Discuss the temperature, pressure and solubility conditions in a hydrothermal method of synthesis of inorganic solids.
d) Explain various steps involved in the sol-gel synthesis of silica nanoparticles.

[4, 4, 4, 3]

4. Q.4

Write short notes on any **THREE** of the following.

a) Fullerides
b) Carbon nanotubes
c) Bioinorganic nanomaterials
d) Co-precipitation method of synthesis of inorganic solid
e) Inorganic liquid crystals

[5 X 3]

(24)

[This question paper contains 2 printed pages.]

Sr. No of Question Paper : 4024 **Your Roll No**.....

Unique Paper Code : **2171604** 2019

Name of the Paper : Organic Chemistry: Chemistry of Biomolecules

Name of the Course : **B.Sc. (Hons.) Chemistry** F-12

Semester : VI

Duration : 3 Hours

Maximum Marks : 75

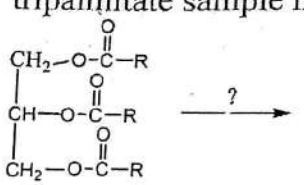
(Write your Roll No. on the top immediately on receipt of the question paper)

Question No. **1** is compulsory. Attempt **six** questions in all.

1. Answer any **five** of the following:
   (a) How does the structure of DNA differ from RNA?
   (b) Define isoelectric point. Calculate isoelectric point of Lysine. Given pK_1 (NH_3)=2.18, pK_2 (COOH)=8.95, pK_3 (side chain)=10.53
   (c) Show the specific hydrogen bonding between adenine and thymine.
   (d) Write two advantage of Dansyl method over Sanger method
   (e) Differentiate between Nucleoside and Nucleotide. Give the structure of deoxycytidine.
   (f) How is pyruvate converted into ethanol under anaerobic condition? Name enzyme and give reaction involved.
   (g) What are essential amino acids? Name any two giving their structures. (3x5)

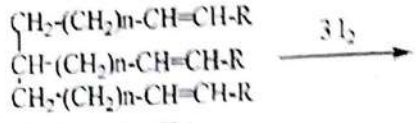
2. (a) What is glycolysis? Give steps involved in conversion of glucose to glyceraldeyde-3-phosphate during glycolysis.
   (b) Give structure of ATP. How many ATP molecules are generated in complete oxidation of glucose into CO_2 and H_2O?
   (c) Outline the solid phase synthesis of Gly-Ala-Val. (4,4,4)

3. (a) Write a short note on Rancidity.Discuss the different types of rancidity.
   (b) Discuss briefly various steps involved in TCA (Kreb's) cycle.
   (c) What is saponification value? Calculate the saponification number of glyceryl tripalmitate sample having molar mass 806. Write the reaction involved.



Molar mass- 806

4. (a) Define Watson - Crick Model of DNA.
(b) How will you synthesized Gly-Ala by DCC method?
(c) What is Iodine number (I.N.)? Calculate I.N of given reaction. What is significance of I.N.?



Molar mass- 884

(4,4,4)

5. (a) One of the strands of DNA molecule shows nucleotide base sequence as 5'-A-G-T-C- A-C-A-G-T-A-C-C-3'. What is the sequence of bases in the complimentary DNA strand and trancripted messenger RNA strand?
(b) What are the types of bonds responsible for stabilizing tertiary structure of proteins?
(c) With the help of a neatly labelled diagram, explain the process of transcription?

(4,4,4)

6. (a) What is drying, non-drying and semi-drying oils? Give examples.
(b) Differentiate between reversible and irreversible inhibition with examples.
(c) Name the different types of RNAs and explain their biological roles.

(4,4,4)

7. (a) Discuss the effect of concentration of the substrate on the rate of an enzyme catalyzed reaction.
(b) What are sphingolipids and glycolipids? Explain.
(c) Show steps of Gabriel pthalimide synthesis of cysteine starting from malonic ester.

(4,4,4)

8. Write short notes on any **three** of the following:
   i) Enzyme specificity
   ii) Secondary structure of protein
   iii) Cofactors and coenzyme
   iv) Liposomes and their biomedical applications.

(4,4,4)