



UNIVERSITY OF THE PUNJAB

Part-II A/2018
Examination:- M.A./M.Sc.

Roll No.

Subject: Chemistry
PAPER: I-A Physical Chemistry (Special)

TIME ALLOWED: 3 hrs.
MAX. MARKS: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

- Q.1. (a) Discuss nuclear fission and nuclear fusion process in detail. 12
(b) What is nuclear decay? Discuss the kinetics of nuclear decay. 13
- Q.2. (a) What is adsorption isotherm? Derive Langmuir adsorption isotherm for adsorption of a gas on solid surface. 10
(b) What is catalysis? Discuss the kinetics of catalytic reaction of a gas on solid surface in detail. 15
- Q.3. Define the term "SOL". Give different methods of preparation of SOL. Discuss the various properties of SOL. 25
- Q.4. What is osmosis and osmotic pressure? How would you determine the molecular weight of macromolecules by Osmometry? 25
- Q.5. (a) What are GELS? Give their classification. Discuss the preparation of GELS. 13
(b) What are EMULSIONS? How can you classify the emulsions? Discuss the kinetic theory of emulsion type. 12
- Q.6. Differentiate between Nuclear and Chemical Reactions. Discuss the use of Tracers in Chemistry 25
- Q.7. Write short notes on any TWO of the following: 25
(i) Enzyme catalysis
(ii) Semi-permeable Membranes and their applications.
(iii) Radioactive equilibrium

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Part-II A/2018
Examination:- M.A./M.Sc.

Roll No.

Subject: Chemistry
PAPER: I-B Inorganic Chemistry (Special)

TIME ALLOWED: 3 hrs.
MAX. MARKS: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

Q. No.1	a) Describe few experimental evidences in favor of d-orbital contraction.	15
	b) Describe various uses of Atomic Absorption spectroscopy.	10
Q. No.2	a) Explain Walsh diagram to describe the structure of water molecule.	10
	b) Describe the principle and working of Atomic Absorption Spectroscopy (AAS).	15
Q. No.3	a) What are Organic Reagents? Discuss their classification.	15
	b) How lattice energy values can be used as criteria of bond type? What are the drawbacks of this concept?	10
Q. No.4	a) Discuss theoretical arguments in favor and against orbital participation.	10
	b) What are Silicates? Discuss their Chemistry.	15
Q. No.5	a) What are Cage compounds? Discuss the cage compounds of Phosphorus.	15
	b) What is the role of thermodynamics in interpretative chemistry? Explain with example.	10
Q. No.6	a) How $d\pi-p\pi$ bonding can be observed in inorganic molecules?	10
	b) How entropy of solid can be determined?	15
Q. No.7	Write note on any TWO of the followings:	2x12.5
	i. Inductively coupled plasma emission spectroscopy	= 25
	ii. Born-Lande equations for lattice energy calculations	
	iii. Anomalies in first and second row of periodic table	

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Part-II A/2018
Examination:- M.A./M.Sc.

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Roll No.
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Subject: Chemistry
PAPER: I-C: Organic Chemistry (Special)

TIME ALLOWED: 3 hrs.
MAX. MARKS: 100

NOTE: Attempt any FIVE questions. All questions carry equal marks.

Q.1	Write down answers to the followings. a) What product would you expect from the reaction of 1,4-dichloro-3-nitrobenzene with sodium amide. Justify answer. b) Alkylation of benzene with excess of ethyl bromide in the presence of AlCl ₃ lead to the formation of 1,3,5-triethylbenzene. Do you agree? Justify answer with mechanism. c) Reaction of benzene with 2,2-dimethylpropanoyl chloride in the presence of AlCl ₃ lead to the formation of <i>t</i> -butylbenzene. Do you agree? Justify your answer. d) Reaction of benzene with isobutyl chloride in the presence of AlCl ₃ leads to the formation of <i>t</i> -butylbenzene. Do you agree? Justify your answer. e) Design a suitable scheme for the synthesis of 1-naphthol from benzene.	5 × 4
Q.2	a) Among <i>p</i> -chlorophenyl and <i>p</i> -methoxyphenyl which group has greater migratory aptitude in Pinacol rearrangement? Justify your answer. b) How will you bring about the following conversions? Draw the complete mechanisms. (i) Propanamide → Ethanamine (ii) Pentan-3-one → Ethyl propanoate (iii) Salicylaldehyde → Catechol	05 3 × 5
Q.3	a) Outline two methods for the synthesis of thiophene ring. b) Electrophilic attack in the thiophene takes place preferably at 2-position. Justify the statement. c) When 2,4,6-trimethylpyrilium tetrafluoroborate is heated with aqueous sodium hydroxide, a carbocyclic system is formed? Draw the structure of the product and outline the mechanism for its formation. d) Propose a suitable mechanism for the Hantzsch synthesis of pyridine ring. e) Describe the role of furan as a diene in Diels Alder reaction with suitable examples.	5 × 4
Q.4	a) What do you know about singlet and triplet nitrenes? How these can be generated. Decorate your answer with suitable examples. b) Discuss the role of nitrenes in heterocyclic synthesis.	10 10
Q.5	a) What do you know about CBz, Boc and Fmoc groups? Discuss their importance in peptide synthesis. b) How would you convert cyclohexanone into caprolactam and caprolactone? c) Trimethylsilyl group usually favours ipso electrophilic substitution in aromatic systems. How would you rectify the statement?	10 06 04
Q.6	a) By using Orbital Symmetry Conservation Theory explain that thermal electrocyclic reaction of conjugated polyene with 4n π electrons would proceed through conrotation while photochemical electrocyclization of this polyene would prefer disrotation. b) By using Frontier Molecular Orbital Theory explain thermal and photochemical [1,3]-sigmatropic migration of carbon. c) What are group transfer reactions? Explain with examples.	10 05 05

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Q.7	a) Design suitable syntheses for the following compounds. i) 1,3-Dimethylpropane-1,3-dione ii) 1,5-Dimethylpentane-1,5-dione iii) 2-Nitrobenzophenone iv) Cyclohex-3-enecarboxylic acid b) Write a comprehensive note on Suzuki coupling.	4 × 3 08
Q.8	a) What mono nitro product would you expect from the following substrates using nitric acid – sulfuric acid mixture and justify your answer. (i) Methyl cinnamate (ii) N-Benzylaniline (iii) 4-Isopropyltoluene (iv) Benzonitrile (v) 2-Chlorotoluene b) What is S_NAr mechanism? Narrate evidences in favour of this mechanism.	5 × 3 05
Q.9	a) Discuss the factors affecting the migratory aptitudes in various rearrangement reactions. b) Discuss the mechanistic aspects of Fries rearrangement. c) Give an account on Benzidine Rearrangement	10 05 05



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Part-II A/2018
Examination:- M.A./M.Sc.

Roll No.

Subject: Chemistry
PAPER: I-D: Bio-Chemistry (Special)

TIME ALLOWED: 3 hrs.
MAX. MARKS: 100

NOTE: Attempt any FIVE questions. All questions carry equal marks.

1. a) Describe the glycolysis in detail and give an account of energy yield in each step of this process. (12)
b) Describe briefly digestion and absorption of carbohydrates. (8)
2. What is the role of pancreatic gland in human? Explain the chemistry, synthesis and biological function of insulin, and glucagon. (3+10+7)
3. a) What are Ketone bodies? And explain the synthesis of ketone bodies (2+8)
b) Explain β -oxidation of Fatty acids in detail. (10)
4. Explain de novo pathway for the synthesis of AMP and GMP from α -D-Ribose 5-Phosphate and how purine biosynthesis regulates? (15+5)
5. a) Explain how proteins are digested and absorbed. (10)
b) Briefly explain the synthesis and degradation of amino acids. (10)
6. a) Discuss briefly oxidative phosphorylation and regulation of ATP production. (10)
b) Give an account of biosynthesis of Palmitic acid. (10)
7. a) Write the function and importance of nucleotides including purine and pyrimidine bases based nucleotides. (3+3)
b) Which kind of hormones secreted by posterior lobe of Pituitary gland? Describe the chemistry and functions of oxytocin and antidiuretic hormones (2+4+8)
8. a) Explain transamination and deamination reactions of amino acids and its importance. (12)
b) Discuss briefly Gluconeogenesis and its regulation. (8)
9. Write notes on any two of the following (10+10)
 - a) Thyroid hormone
 - b) Prostaglandins
 - c) HMP pathway

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Part-II A/2018
Examination:- M.A./M.Sc.

Roll No.

Subject: Chemistry
PAPER: I-E: Analytical Chemistry (Special)

TIME ALLOWED: 3 hrs.
MAX. MARKS: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

- Q1. a) Discuss the detail note on the application of Gas Chromatography in Chemistry. 10
b) Discuss the instrumentation and working of GC/GLC. 15
- Q2. a) Discuss the solvent delivery systems used in HPLC. 10
b) Discuss the instrumentation and working of high performance liquid chromatographic apparatus. 15
- Q3. a) How ion selective electrodes evolve with the discovery of membrane electrodes works. 15
b) Write a note on reference electrodes. 10
- Q4. a) Write a not on the electrodes of metallic indicator electrodes. 15
b) Discuss the direct and indirect applications of Conductometry in Chemistry. 10
- Q5. a) Write a note on advanced voltametric methods/ polarographic methods. 15
b) Discuss various factors which affect half wave potential. 10
- Q6. a) Why we need two micro electrodes in amperometric titrations, while single Micro-electrode amperometry can give sufficient information. Discuss instrumentation of amperometric titration apparatus and its workings. 15
b) Write a note on amperometric titrations. 10
- Q7. a) Write general principle and instrumentation and application of TGA. 15
b) Discuss various factors which affect TGA results.
c) Differentiate between DTA and DSC, What does enthalpy represent and what type of information it provides. How is it determined. 10



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Part-II A/2018
Examination:- M.A./M.Sc.

Roll No.

Subject: Chemistry
PAPER: I-F: Applied Chemistry (Special)

TIME ALLOWED: 3 hrs.
MAX. MARKS: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

Q. 01	a. What are different sources of the raw materials for paper manufacturing? Write down in detail.	12
	b. What are sulphate and sulphite processes for paper manufacturing. What are the major difference between these processes and how these processes effect on the quality of paper?	13
Q. 02	a. Describe the manufacturing and uses of potash fertilizers.	15
	b. Explain the synthesis of urea with the help of complete flow sheet diagram.	10
Q. 03	a. Differentiate drying oil, fixed oil and essential oil. Explain their differences on the basis of the molecular structures and support your answer with suitable examples. Also write down their industrial uses.	10
	b. Write down complete process of conversion of vegetable oil in to vegetable Ghee. Support your answer with diagram and chemical reactions where required.	15
Q. 04	a. What are different types/ grades of polyethylene? Write down complete process of the manufacturing of high density polyethylene. Also write down important industrial uses of the high density polyethylene.	13
	b. How polymers can be classified on the basis of their different properties (At least five). Write in detail and also give at least one example for each of the class.	12
Q. 05	a. How acetylene, ethylene and propylene can be prepared. Also mention their industrial significance.	20
	b. Briefly describe the origin of petroleum	5
Q. 06	a. What are the different environmental issues generated by a leather industry. What considerations should be made for the erection of a new tannery to minimize these environmental issues?	10
	b. Write down in detail the complete process of vegetable tanning including all pre-tanning and post tanning processes with the help of flow sheet diagram.	15
Q. 07	Write short note on the following.	
	a. Ionic polymerization	05
	b. Reforming of petroleum	05
	c. Difference between fats, oils and waxes	05
	d. Fractional distillation	05
e. Halogenation and nitration of benzene	05	

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Part-II A/2018
Examination:- M.A./M.Sc.

Roll No.

Subject: Chemistry
PAPER: II-A [Physical Chemistry (Additional)]

TIME ALLOWED: 3 hrs.
MAX. MARKS: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

1. a) Explain classification of polymers on the basis of structure and application. (5)
b) What is polymerization? Give different methods of preparation of polymers. (8)
c) Discuss the kinetics of the free radical polymerization. (12)
2. a) What is principle of electronic transitions? Give different types of electronic transitions (12)
b) What is Raman spectroscopy? Discuss pure Raman spectra of linear molecules. (13)
3. a) Write a note on application of IR spectroscopy. (13)
b) What is nature of light radiations? Classify different types of spectroscopy on the basis of spectral region. (12)
4. a) Derive expression for the rotational energy of diatomic molecule using quantum mechanical method. (15)
b) Discuss different types of vibrational modes in polyatomic molecules. (10)
5. a) Differentiate between fluorescence and phosphorescence. (15)
b) Write a note on photosensitized reaction. (10)
6. a) Explain thermodynamics for real solution. (15)
b) What are the conditions of equilibrium between phases. (10)
7. Write notes on **TWO** of the followings: (12.5 +12.5)
 - a) Separation of solid solutions
 - b) Osmosis and osmotic pressure method for molar mass determination
 - c) LASER

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Part-II A/2018
Examination:- M.A./M.Sc.

Roll No.

TIME ALLOWED: 3 hrs.
MAX. MARKS: 100

Subject: Chemistry
PAPER: II-B [Inorganic Chemistry (Additional)]

NOTE: Attempt any FOUR questions. All questions carry equal marks.

- Q. No.1 a) What are Metallocenes? Describe the chemistry of chromocene. 12
b) What is tracer technique? Explain its application in chemistry, medicines and industry? 13
- Q. No.2 a) Discuss the structure, specific properties and role of chlorophyll in photosynthesis. 10
b) How radioactivity can be detected and measured by different instruments with accuracy? 15
- Q. No.3 a) Compare different type of chemical reactions carried out in liq.NH₃ and liq.SO₂. 12
b) Discuss the redox reactions with Inner and Outer Sphere Mechanism giving suitable examples. 13
- Q. No.4 a) Describe chemistry of Spinel. 10
b) What is the role of organometallic compounds in health and industry? Explain with suitable examples. 15
- Q. No.5 a) Explain Substitution reactions in square planer system. 10
b) What are siderophores? What are their functions in living system? 12
c) What are the limitations in using ammonia as solvent? 03
- Q. No.6 a) Describe fluxional behaviour in organometallic compounds with suitable examples. 13
b) Explain biochemistry of the nonmetals with reference to human beings? 12
- Q. No.7 Write note on any TWO of the followings:
(a) High temperature superconductors 2x
(b) Physiology of blood 12.5=
(c) Electrode potential and its measurement 25

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Part-II A/2018
Examination:- M.A./M.Sc.

Roll No.

Subject: Chemistry
PAPER: II-C [(Organic Chemistry (Additional))]

TIME ALLOWED: 3 hrs.
MAX. MARKS: 100

NOTE: Attempt any FIVE questions. All questions carry equal marks.

Q. No. 1. Answer the following questions. (4 x 5 = 20)

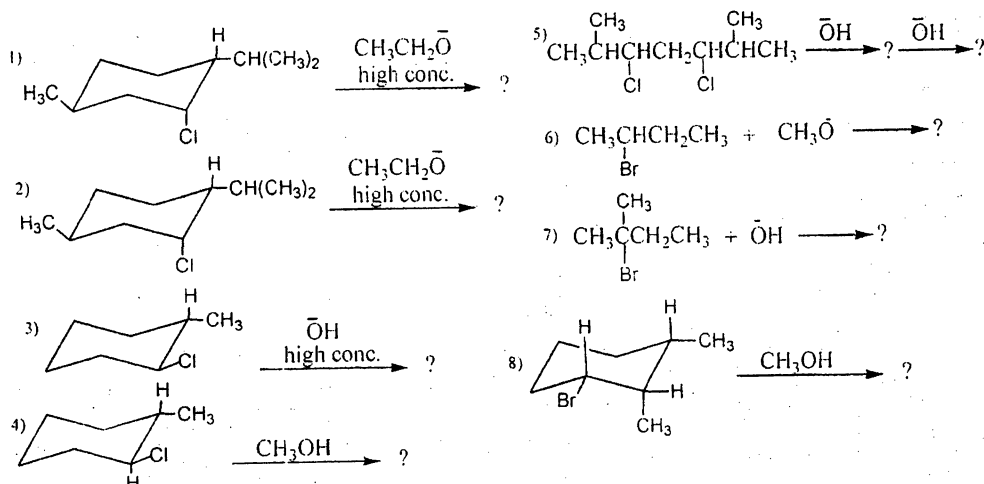
- Why only a small quantity of the sample (in the vapour state) is used for analysis in the mass spectrometer?
- Explain why the deuterium-coupled ^1H -spectrum of cyclohexane- d_{11} contains only a sharp singlet at room temperature but two singlet at 170 K.
- In benzaldehyde, two of the ring protons have resonance at 7.87 ppm, and the other three have resonance in the range from 7.5 to 7.6 ppm. Explain.
- Arrange the following protons in the decreasing order of their δ values in ^1H -NMR and account for your order: Methyl, ethylenic, acetylenic, aryl and aldehydic.
- How will you distinguish between CH_3Cl , CH_3Br , and CH_3I by mass spectrometry?

Q. No. 2. Answer the following questions. (10+5+5).

- Explain Saytzeff and Hofmann products during elimination reactions.
- Explain E1cB reaction and its mechanism with examples.
- Give details of isotopic method for determination of reaction mechanism.

Q. No. 3. Answer the following questions. (15 + 5)

a) Draw the product of following elimination reactions.



b) Among the halide ions which is best nucleophile in a protic solvent? Justify your answer.

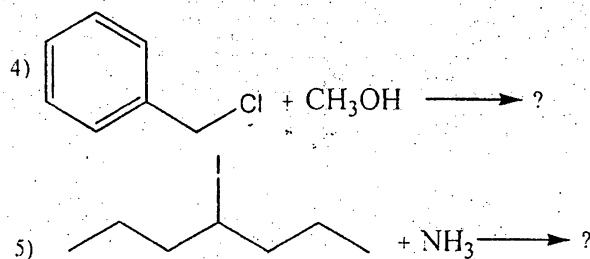
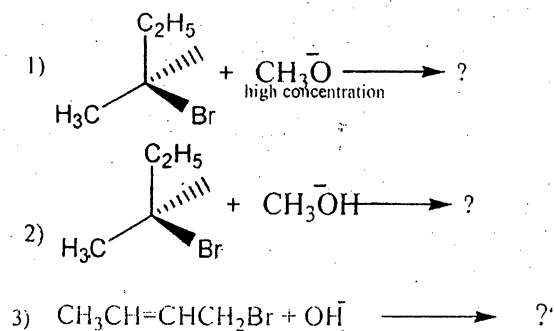
Q. No. 4. Answer the following questions. (8+8+4)

- Explain the effects of attacking nucleophile on rate of aliphatic nucleophilic substitution reactions.
- Explain with example that C=C acts as neighbouring group in aliphatic nucleophilic reactions.
- Explain the effect of solvent on rate of $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ reactions.

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Q. No. 5. Answer the following questions. (5 + 10 + 5).

- (a) Most of SN1 reactions are take place with partial racemization. Explain Briefly.
 (b) Complete the following reactions. Write their mechanism. Comment on your choice of SN1 or SN2 modes.



- (c) Explain why vinylic halide and aryl halide do not undergo SN2 or SN1 reaction.

Q. No.6. Answer the following questions. (10 + 10)

- a) What are terpenes? Draw all the steps involved in the biosynthesis of isopentyl pyrophosphate.
 b) Write a short note on alkaloids. Briefly explain at least 5 different classes of alkaloids.

Q. No.7. Answer the following questions. (7 + 6 + 7)

- a) The mass spectrum of O-nitrotoluene shows a prominent peak at m/z 120, but the similar peak in the case α , α -trideutero-O-nitrotoluene appears at m/z 122 instead of m/z 120. Explain.
 b) Briefly explain the quadrupole mass analyser in mass spectrometer.
 c) Define ionization. Briefly explain the different modes of ionization in mass spectrometry.

Q. No 8. Answer the following questions. (8+12)

- (a) Write the structure of the compounds with the following molecular formula that show only one signal each in their PMR spectra.
 (i) C_5H_{12} ii) C_3H_6 iii) C_3H_4 iv) C_4H_6 v) C_8H_{18} vi) $\text{C}_2\text{H}_6\text{O}$
 (b) Deduce the structure of each of the following compounds on the basis of their molecular formula and PMR data.

- i. $\text{C}_{10}\text{H}_{14}$: δ 1.3 (9H, singlet) and 7.0-7.5 (5H, multiplet)
 ii. C_6H_{14} : δ 0.9 (12H, doublet) and 1.4 (2H, heptet)
 iii. $\text{C}_4\text{H}_6\text{Cl}_4$: δ 3.9 (4H, doublet) and 4.6 (2H, triplet)
 iv. $\text{C}_3\text{H}_7\text{OCl}$: δ 2.0 (2H, quintet), 2.8 (1H, singlet), 3.7 (2H, triplet) and 3.8 (2H, triplet).

Q. No.9. (15 + 5)

- a) What fragments are expected as a result of McLafferty rearrangement in the following compounds?
 i) 5-Methyl hexanal, ii) 4-Methyl-2-pentanone, iii) 2-Butylcyclohexanone,
 iv) Butyl 2,2-dimethylpropanoate, v) 2-Ethylhexanoic acid.
 b) The mass spectrum of 3-butyn-2-ol shows a large peak at $m/z=55$. Draw the structure of the fragment and explain why it is particularly stable.

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Part-II A/2018
Examination:- M.A./M.Sc.

Roll No.

Subject: Chemistry
PAPER: II-D [Biochemistry (Additional)]

TIME ALLOWED: 3 hrs.
MAX. MARKS: 100

NOTE: Attempt any FIVE questions. All questions carry equal marks.

- Q.1.a. What are plasma proteins? How these can be fractionated? Give their role in biological systems. (12)
- b. What are formed elements of Blood? (08)
- Q.2. Define immunity, what is the role of complement system in the field of immunity? What factors are responsible for its activation? (20)
- Q.3. Write down biochemical importance of Vitamins in biological system. Write biochemical functions, deficiency symptoms and requirements of Vitamin A. (20)
- Q.4. Describe the general procedure for extraction, fractionation and purification of proteins. Discuss the SDS-PAGE in detail. (20)
- Q.5. What is fermentation biotechnology? Write a detailed note on industrial production of vinegar by fermentation. (20)
- Q.6.a. Explain the structure and detoxification function of Liver. (12)
- b. Explain Radioisotopes? Write practical applications of radioisotopes in the field of biochemistry. (08)
- Q.7.a. Discuss different phases of bacterial growth also draw the growth curve showing different phases. What factors effect the growth of microbes? (12)
- b. Describe composition of culture media. (08)
- Q.8. Describe the GENETIC CODE and explain all steps and factors involved in the mechanism of transcription. Also discuss post transcriptional modifications. (20)
- Q.9. Write a note on any TWO of the following: (10+10)
- Plasmids
 - ELISA
 - X-Ray diffraction
 - Composition of CSF



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Part-II A/2018
Examination:- M.A./M.Sc.

Roll No.

Subject: Chemistry
PAPER: II-E [Analytical Chemistry (Additional)]

TIME ALLOWED: 3 hrs.
MAX. MARKS: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

Question No.	Questions	Marks
Q.1 a)	How do compare Raman with IR spectroscopy. Discuss in detail?	10
b)	Briefly discuss the operation of single and double beam Infrared spectrophotometer.	8
c	What is the basic principle of raman spectrometry? Briefly discuss.	7
Q2. a)	What is meant by uv/vis spectroscopy. Give briefly description of filters and detectors in uv/vis spectrophotometer.	10
b	Draw the optical layout of single and double beam spectrophotometer?	07
c	Make the comparison between atomic energy and molecular energy level	08
Q3.a	Briefly discuss the energy level diagram in order to explain fluorescent behavior of atoms?	8
b	Briefly discuss the limitations of fluorescence and its application	9
c	Explain the instrumentation starting from sample introduction system till detection devices in ICP-OES.	8
Q4a	What are the stimulated emission population inversions? Briefly discuss it.	08
b	Briefly explain the types of laser?	09
c	What is basic principle of laser operation?	08
5 a	Briefly discuss the NMR spectroscopy. Which type of solvent could be used in NMR spectrum	08
b	How do factors effect on chemical shift in NMR spectroscopy?	10
c	What type of analytical information can be collected from NMR spectrum? Discuss application of NMR spectroscopy.	07
Q6 a	What is meant by gas phase source? Explain it with one example?	08
b	Briefly discuss about soft ionization source in mass spectrometry?.	07
c	Write down detailed features of mass analyzers.	10
Q7	Write notes on any three of the following Origin of Infrared Spectra Chemical shifts MALDI Photomultiplier detector ICP-Tor	25



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Part-II A/2018
Examination:- M.A./M.Sc.

Roll No.

Subject: Chemistry
PAPER: IV (Environmental Chemistry)

TIME ALLOWED: 3 hrs.
MAX. MARKS: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

- Q.1 (a) What is SOIL EROSION? Give its causes and environmental impact. (12)
(b) Give the NEQS for Drinking water. (8)
(c) Give significance of ENVIRONMENTAL MONITORING? (5)
- Q.2 (a) Write a detailed note on Acid Rain. (8)
(b) Write down the discharge limits for wastewater? (8)
(c) What are the main environmental problems caused by Cd? (9)
- Q.3 (a) Discuss the application of GC and HPLC in environmental monitoring. (10)
(b) What methods can be used for determining total dissolved solids (TDS)? (8)
(c) What is the purpose of the return sludge step in the activated sludge process? (7)
- Q.4 (a) Briefly describe the different types of wastewater treatment (primary, secondary, tertiary)? (10)
(b) Differentiate between clays, silts, sands, gravel also describe their role in fertility? (8)
(c) What are some characteristics of radionuclides that make them especially hazardous to humans? (7)
- Q.5 (a) What is the tropopause? What crucial protective function does it serve? (10)
(b) Describe the chemical principles of the dichromate and permanganate methods for COD determination. (8)
(c) What are major chemical pollutants in the pedosphere/soil? (7)
- Q.6 (a) What are the main N compounds in natural waters and wastewaters and what are their typical concentrations? (10)
(b) Give major advantages and disadvantages of using ozone dioxide for water disinfection? (8)
(c) Write a note on characteristics of different zones/regions in a soil profile? (7)
- Q.7 (a) What chemical species are most generally responsible for the removal of hydroxyl radical from the unpolluted troposphere? (8)
(b) Give a reaction that explains why NO₂ is a key species involved in air pollution and the formation of photochemical smog. (8)
(c) What are the reasons that soap is environmentally less harmful than alkyl benzene sulfonate (ABS) surfactant used in detergents? (9)