

QUESTION BANK: UG

Department of Chemistry

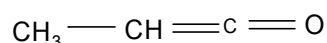
UG Semester –I

Semester –I

Paper-C1T

(Organic Chemistry)

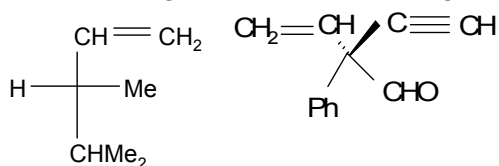
1. Draw orbital picture of the following:



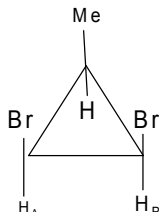
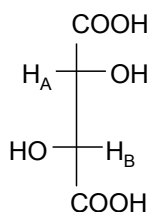
2. Give an example of axially chiral molecule indicating the chiral axis.

3. Represent meso-tartaric acid in Fisher projection formula.

4. Designate the configuration of the following compound by R-S notation:



5. State whether the marked hydrogens H_A and H_B are homotopic, enantiotopic or diastereotopic in each example given below



6. State what elements of symmetry are present in the following molecule:

(1) Benzene

7. State Huckel's rule of aromaticity. Indicate the following carbocycles as aromatic, non-aromatic or anti-aromatic one:

(1) Cyclooctatetraene

(2) Cyclobutadiene

8. Staggered ethane molecule belongs to D_{3d} point group -justify

Semester –I

Paper-C2T

(Physical chemistry)

1. Write the postulates of kinetic theory of gases.
2. Write the equation of state for "N" mole of real gas.

- Write the first law of Thermodynamics. What is Intensive and extensive properties?
- Derive a relation of heat at constant volume and constant pressure.
- Write two statements of 2nd law of Thermodynamics.
- State and explain the dependence of temperature on reaction rate.
- What are the unit of 'a' and 'b'?
- What is first order reaction?
- What is difference between order and molecularity?
- What is entropy? Give its unit.

Semester –I

Paper-DSC-1A

- ১। কক্ষ ও কক্ষকের পার্থক্য লেখ।
- ২। আয়নীয় যৌগের জালকশক্তি সমযোজী যৌগের জালকশক্তি অপেক্ষা বেশি কেন?
- ৩। গ্লিসার্যাল ডিহাইড্রের D এবং L গঠনাকৃতি লেখো?
- ৪। ট্রান্স ১-বিউটিন থেকে সিস ২-বিউটিন কীভাবে রূপান্তর করবে?
- ৫। একটি H পরমানুর দ্বিতীয় বোর কক্ষের ব্যাসার্ধ নির্ণয় করো?
- ৬। BeCl_2 অনুটি অম্লীয় কিন্তু NaCl ধূবীয় কেন?
- ৭। D ও L টারটারিক অ্যাসিডদ্বয় আলোক সক্রিয় কিন্তু মেসো টারটারিক অ্যাসিড নয় কেন?

UG Semester –II

Semester –II

Paper-C3T

(Inorganic Chemistry)

- Calculate the energy of the electron in the third orbit of He^+ cation.
- : 1) what is Rydberg constant? Is it a true constant?
- Reduce mass is constant for heavier element- Comment.
- Which quantum number solely determine the allowed energy for a hydrogen like atom? Write the expression for energy and explain the term and sign involved there in.
- Explain the significance of the different m_l values corresponding to $\ell = 1$.
- in an atom, the angular momentum of an electron is $\sqrt{6} \frac{h}{2\pi}$, What will be the minimum value of the principal quantum number of the electron?

7. Calculate the de-Broglie wavelength of 6s electron of Hg moving with a speed $\frac{1}{6}$ th that of light. Velocity of light = 3.0×10^8 m/sec.
8. Calculate theoretical uncertainty in its position within 1m/s for an electron moving at 100 m/s
9. Write the conditions or characteristics of eigen functions
10. Write the Schrodinger wave equation in polar co ordinate.

UG Semester –III

Semester –III

Paper-C5T

(Physical Chemistry)

1. Write the temperature Variation of Viscosity of liquids.
2. State specific conductance and molar conductance.
3. Explain variation of specific and equivalent conductance with dilution for strong and weak electrolytes.
4. Find the relation between k_p and k_c for a chemical reaction.
5. What do you mean by “relaxation effect” of ionic atmosphere?
6. What do you mean by Eigen function and Eigen value?
7. Give an example of abnormal transport number.
8. What is equivalent conductance?
9. Write down the time dependent Schrodinger equation.
10. State the Fick’s law.

Semester –III

Paper-C6T

(Inorganic Chemistry)

1. Write the conditions to develop LCAO.
2. Write the Born Land Equation for $MgBr_2$. And explain the terms involving in it.
3. Give the structure of I_3^- and ICl_4^- ; explain using VSEPR theory.
4. Draw the probable orbital overlap between 3p and 3d for bonding, anti-bonding and non-bonding.
5. Give example of quadruple bond and delta bond.
6. Arrange according the melting point

SnF₂, SnF₄, SnCl₂ and SnCl₄

7. Predict the shape of CH₃[·] and CF₃[·] using Bent's rule.
8. What Bent's rule?
9. What will happen when NaCl crystal is kept in Na vapour.
10. Why ZnO is yellow in hot condition?

Semester –III

Paper-C7T

(Organic Chemistry)

1. It is often preferable to prepare alkyl benzene by acylation followed by clemmensen reduction rather than by direct alkylation-justify.
2. Cadmium dialkyl is better than Grignard reagent for the preparation of a ketone from an acid chloride-explain.
3. What is the role of cyanide ion in benzoin condensation?
4. O-bromoanisole on treatment with NaNH₂ in liq NH₃ produces m-methoxyaniline predominantly –explain.
5. Benzene diazonium chloride does not couple with anisole but p-nitrobenzene diazonium chloride does so-explain.
6. Addition of bromine to cis-2-butene gives a d,l-pair whereas addition trans-2-butene gives a meso compound. Write the stereo structure of product and explain.
7. Trans-2-butene is treated separately with I₂/AgOAc under dry and moist condition- Give Mechanism.
8. What is pinacol pinacolone rearrangement?
9. What is Wittig reaction?
10. What is benzoin condensation?

Sem-III

Sub: SEC-1T

(Pharmaceutical chemistry)

1. What is Drug? Why food is excluded from Drug?
2. What is the Principle Of anchor Concept?
3. Essential steps involved in drug design.
4. What are Agonist and antagonist? Give example.

5. Write the synthesis of Ibuprofen.
6. Retro synthesis and synthesis of Phenobarbital.
7. Write down the synthesis of paracetamol.
8. Write two example of anti bacterial drugs.
9. What is the formula of aspirin? Give its use.

Sem-III

Paper: DSC-1

- ১। আর্দ্র দ্রবনের ক্ষেত্রে রাউল্টের সূত্রটি লেখ?
- ২। আয়নের স্বাধীন বিচরণের ক্ষেত্রে কোলরাশের সূত্রটি লেখ।
- ৩। নার্নস্টের সমীকরণটি লেখ। এর গুরুত্ব বলো।
- ৪। পার্কিনের বিক্রিয়াটি লেখ।
- ৫। আইসোইলেকট্রিক পয়েন্ট কাকে বলে?
- ৬। মিউটারোট্রোন কাকে বলে?
- ৭। ইনভারসান অফ কেন সুগার কি?
- ৮। কার্বিল অ্যামিন বিক্রিয়াটি লেখ।
- ৯। 10^{-4} M দ্রবনের pH কত?

Sem-III

Paper: GE-3

- ১। লা-স্যতেলিয়ার নীতি টি লেখ।
- ২। k_p ও k_c এর মধ্যে সম্পর্কটি কী?
- ৩। প্রমাণ করো যে রাসায়নিক সাম্য একটি গতিশীল পক্রিয়া?
- ৪। আরহেনিয়াস তত্ত্বটি কি এবং সাফল্য ও অসাফল্য লেখ?
- ৫। ভরক্রিয়ার সূত্রটি লেখ?
- ৬। তীব্র অ্যাসিড ও মৃদু অ্যাসিড কী?
- ৭। বাফার ক্রিয়া বলতে কী বোঝ?
- ৮। দ্রাব্যতা ও দ্রাব্যতা গুণফল এর মধ্যে পার্থক্য কী?

UG Semester –IV

Semester –IV

Paper-C9T

(Inorganic Chemistry)

1. Which of the following are Werner type and non Werner type complex [Pt(C₂H₄)Cl₂], [Co(NH₃)₆]Cl₃, [Cr(C₆H₆)(CO)₃], Na₂(Ni(CN)₄)
2. Molar conductances at a dilution of 1024 lt of PtCl₄. 2NH₃, PtCl₄. 3NH₃, PtCl₄. 6NH₃ are 797 and 520 $\text{ohm}^{-1}\text{cm}^2$ respectively. Rationalize the data in the light of Warner theory.
3. Write IUPAC nomenclature of the following complexes
 - a) [Co(NO₂)₃](NH₃)₃
 - b) [CoCl(CN)NO₂(NH₃)₃]
 - c) [(CO)₅ – Re – Co(CO)₄]
 - d) [Pt(Py)₄][PtCl₄]
 - e) K[PtCl₃(C₂H₄)]
4. Write the formula of complexes from given name
 - a) Potassium tetrachloridopalladate (II)
 - b) Potassium pentachloridonitridoosmate (2-)
 - c) Tris(ethane-1, 2-diamine) cobalt (III) chloride
 - d) nonacarbonylrheniumcobalt
 - e) Bipyridinebis (ethylenediamine) cobalt (III) ion
 - f) Bipyridinebis (ethylenediamine) cobalt (3+)

UG Semester – V

UG Sem – V

Paper: C11T

Inorganic Chemistry

1. Mn(CO)₅ does not but its dimer Mn₂(CO)₁₀ is stable. Explain?
2. [NiCl₄]²⁻ is paramagnetic but [Ni(CN)₄]²⁻ is diamagnetic. Explain.
3. High spin octahedral complex of Co(III) is very rare. Explain.
4. Cu, Ag, Au belong to same family (group IB), but their oxidation state is different.
5. [Ni(H₂O)₆]²⁺ is green but [Ni(en)₃]²⁺ is blue. Explain.

- Write down the structures of all possible isomers of MA_4B_2 and $M(AA)_2B_2$ (where A is mono dentate and AA is bi dentate ligands).
- Explain the energy ordering
- Write down the steps to high yields synthesis of Cis-platin.
- Standardisation of $KMnO_4$ solution by the standard Oxalic acid solution needs initial warming and reaction rate is very slow at first phase while the reaction becomes faster with time. Explain.

Semester – V

Paper-C12T

(Organic Chemistry)

- 'Mutarotation of D-glucose is facile in presence of 2-hydroxypyridine instead of pyridine alone' - Explain.
- What do you mean by the term 'epimer' ? Give example.
- Starting from D-glucose complete the following sequence with appropriate reagents:
 $D\text{-glucose} \rightarrow \text{Osazone} \rightarrow \text{Osone} \rightarrow D\text{-Fructose}$
 Type equation here.
 (a) (b) (c)
 Give the mechanism of the step (a) Type equation here. \rightarrow (b) only
- Fructose is a reducing sugar in spite of the fact that it has no free $-\text{CHO}$ group. Explain it.
- D-(+)- Glucose and D-(+)-mannose is an epimers. Explain.
- How will you determine N-terminal amino acid residue of a poly peptide.
- Covert D-glucose \rightarrow L- glucose
- Covert Naphthalene \rightarrow Anthracene
- Thiophene \rightarrow
- Pyrofene
- Identify A and B
 $D\text{-glucose} \rightarrow A+B$
- Draw an Energy-profile diagram for monomethylcyclo-hexane showing 1,3-diaxial nonbonded interactions

Semester – V

Paper-DSE1T

(Advanced physical chemistry)

- Equilibrium state is the state with maximum thermodynamic probability. Explain
- Write down the Maxwell-Boltzmann statistics.
- Calculate the no. of molecules in each of two level system where both are one fold degenerate. How will they vary with the change in temperature?
- The molecules of gas have two energy states, zero and ϵ and degeneracies g_1 and g_2 respectively. Write down the expression for molecular partition function

5. Calculate the rotational partition function for N_2 molecule at 27° C temp. The internuclear distance of N_2 is 109.76 pm.
6. State Debye T^3 law.
7. Define “Phase space”.
8. What do you mean by “Ensemble”?
9. What is thermodynamic probability ?
10. Write the relation between entropy and thermodynamic probability?
11. State how Boltzmann Distribution law is helpful to calculate the ratio of population.
12. What is molar partition function?
13. What is the molecular partition function for large molecules with large moment of inertia at temperature above 10° K.
14. Write the vibrational energy from harmonic oscillator and also find the energy measured from zero point energy.
15. Derive equilibrium constant in terms of partition function .
16. Write the expression of chemical potential in terms of partition function.
17. What is electronic partition function?

B.Sc. Sem – V

Paper: DSE2T

Analytical methods in Chemistry

1. What do you mean by Bathochromic shift?
2. Ethylene absorbs 164 nm in UV whereas 1,3 Butadiene absorbs at 217 nm. Explain.
3. What is the finger print region in IR spectroscopy?
4. What is AAS?
5. What is Lambert Beer law?
6. Define deviation of Lambert Beer law.
7. What is HPLC?
8. What is TLC?
9. What is paper chromatography?
10. Write down the full name of GC and GCMS.

QUESTION BANK: PG

Department of Chemistry

PG SEMESTER- I

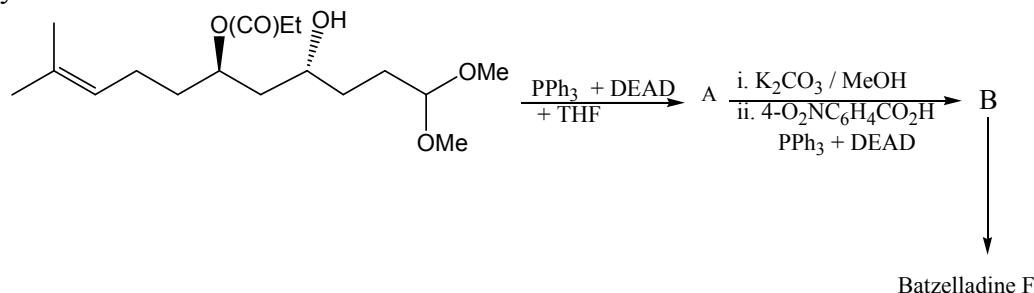
Physical Chemistry Paper 101

1. Find the commutators $[x^3, \frac{d}{dx}]$
2. Show that $\sin nx$ (n is an integer) is an eigen function of the operator $\frac{d^2}{dx^2}$
3. What do you mean by Phase space?
4. Write the difference between Joule-Thomson expansion and adiabatic expansion.
5. What is nanoparticle?
6. Write the specialty of nano structure than its bulk.
7. What is micro canonical ensemble.
8. Which of the following will show a pure rotational spectrum H_2 ; HCl ; H_2O ; CH_4 ; CH_3Cl ; NH_3 ; & CO
9. If $\hat{A} = \frac{d^2}{dx^2}$ and $\hat{B} = x$ find out $[\hat{A}\hat{B} - \hat{B}\hat{A}] f(x)$
10. Show that the eigen function of any two states for particle in a box are orthogonal.
11. Derive the relation between entropy and thermodynamic probability
12. Derive an expression of chemical potential in terms of partition function.
13. Calculate the molar entropy of Ne at 300K and 1 bar assuming that the electronic state of Ne is non degenerate ($1 \text{ bar} = 10^5 \text{ Nm}^{-2}$)
14. Write classification of nano structures with example.
15. Derive an expression for fugacity of Vanderwaal gas neglecting the inter molecular attraction and hence find out the value of fugacity at 20 atm and 300K assuming $b = 0.043 \text{ lit. mol}^{-1}$
16. Calculate J_{\max} for a rigid diatomic molecule for which the rotational constant $B = 1.567 \text{ cm}^{-1}$ and $T = 300\text{K}$.
17. Describe the synthetic routes of nanoparticles. Write the applications of nanoparticles in different fields.
18. Derive rotational partition function for diatomic molecules.
19. Show that $J_{\max} = \sqrt{\frac{KT}{2Bhc}} - \frac{1}{2}$ corresponding to the maximum population of the molecules in the rotational spectra
20. Derive Gibbs Duhem equation for chemical potential and write the conditions of spontaneity and equilibrium from the above equation.

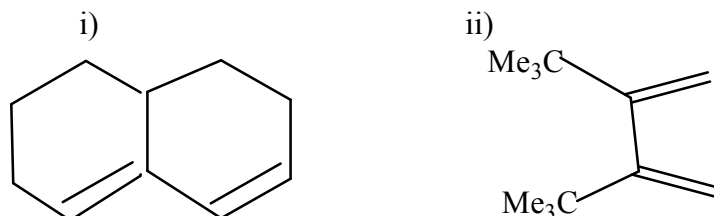
Organic Chemistry

Paper 102

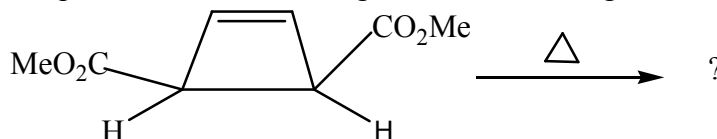
- Write Woodward-Hoffmann selection rule for electrocyclic reaction.
- What is isoprene rule?
- Identify A and B



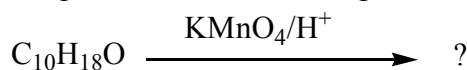
- Why are the following dienes not suitable for Diels-Alder reaction?



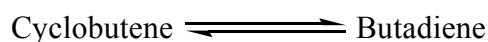
- What is multicomponent reaction?
- Predict the product of the following reaction indicating FMO interactions?



- What is phase transfer catalyst? Give example.
- Predict the product of the following reaction.

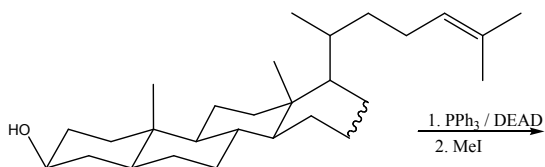


- Draw the correlation diagram for the following interconversion under thermal condition.

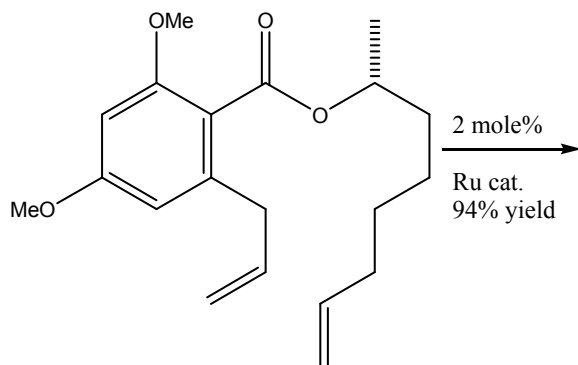


Indicate the symmetry allowed path for the reaction.

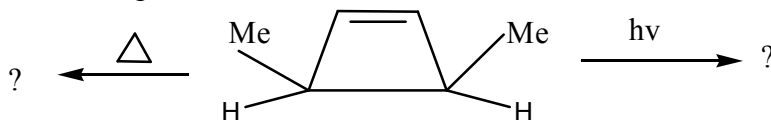
- Predict the product(s) of the following reactions.



11.

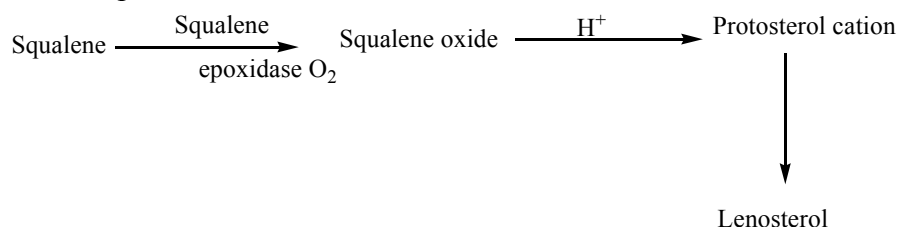


12. In what path way the following ring opening reaction take place? Indicate the most favorable path in each reaction.

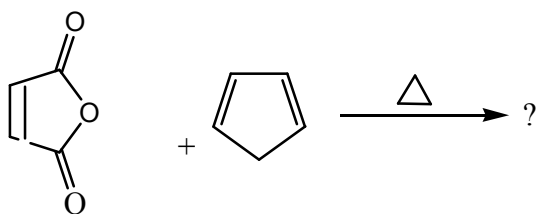


13. What is cycloaddition reaction? What is electrocyclic reaction?

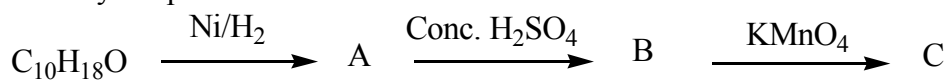
14. Write down the product structure with mechanism



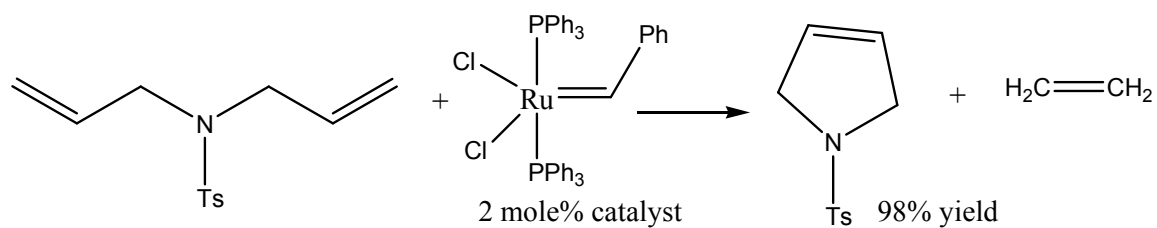
15. Indicate whether exo or endo product will be predominant in the following reaction.



16. Identify the product A to C.

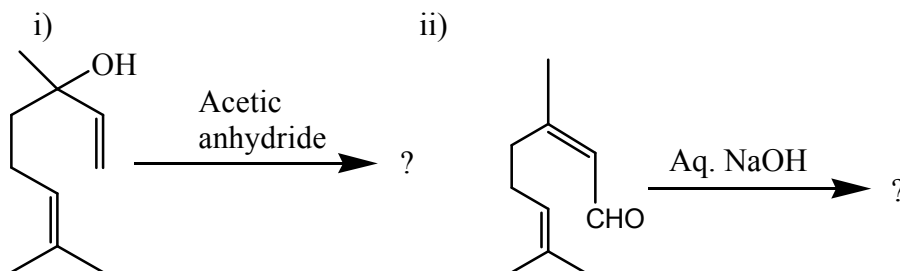


17. Explain the product formation with mechanism



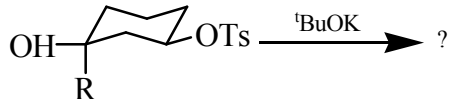
18. How many isomers are possible from citral ($C_{10}H_{16}O$)? Confirmed the structure by NMR evidence.

b) Predict the product of the following reactions?

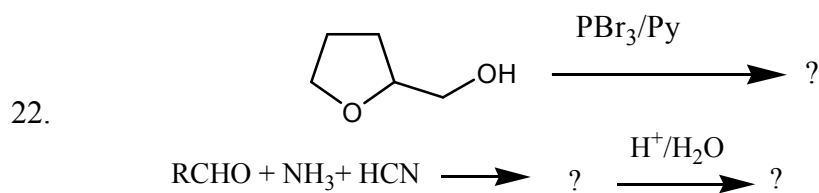


19. Predict the product of the following reaction with mechanism?

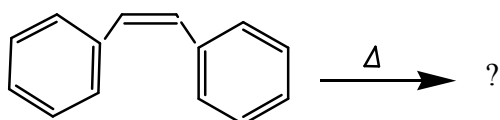
20.

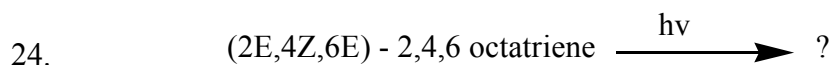
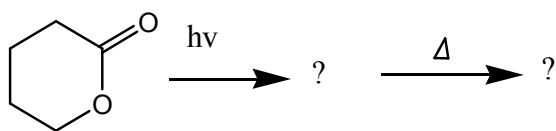


21.

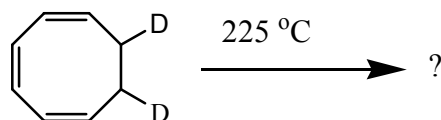


23. Predict the product (s) of the following reactions indicating FMO interactions?

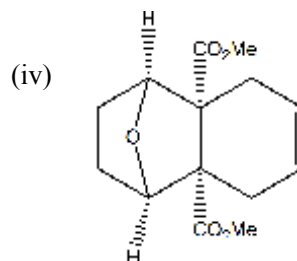
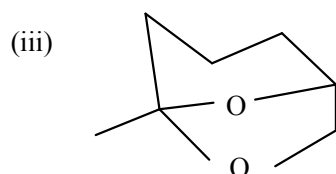
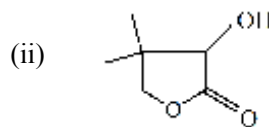
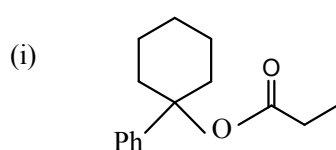




25.



26. Give the retrosynthetic approach and their synthesis strategies of the following compounds.



Inorganic Chemistry

Paper 103

1. Define glide plane.
2. What is the main difference between two space groups: $P3_1/c$ and $P2_1/c$ in crystal system?
3. What are F-centre and F_A -center ?
4. Write the GOT and characterize the terms involved in it.
5. Show that $C_2(x)C_2(y) = C_2(z)$
6. Why H-M rotation for D_4d point group is not possible?
7. Give the name Na and Ca carrying ionophores.
8. What is the role of globin chain in Hemoglobin?
9. What do you mean by sphere of reflection? Derive Bragg law from the concept of sphere of reflection.
10. What do you mean by atomic form factor? Explain why it is not possible to distinguish by X-ray diffraction, two different atoms which differ only by the possession of one additional electron.
11. Show that the number of Schottky defects increases exponentially with absolute temperature.

12. Construct matrix representation of rotation symmetry by an θ , where three Cartesian axes serve as base vectors.
13. Find the matrix representation of the symmetry operations of H₂O molecule using Cartesian co-ordinate as base vector.
14. "No two classes of a group can share a common element" prove the statement.
15. Describe the structure of Hemerithin and discuss the mechanism of O₂ transport of Hr.
16. What is tiger mechanism? Indicate the driving force behind it
Prove that *fcc* lattice is reciprocal to *bcc* lattice.
17. What are 14 Bravis lattices? Face centered and body centered Bravis lattice are included in cubic crystal system but end centered Bravis lattice is excluded in cubic crystal system-Explain.
18. What is the essential condition for obtaining bright spot during the diffraction of light by a diffraction grating?
19. Differentiate between extrinsic semiconductor and intrinsic semiconductor
20. What is drift velocity?
21. ZnO is white in colour at room temperature but on heating it turns yellow-Explain.
22. What do you mean by improper axis of rotation? Find the symmetry elements present in CH₄ molecule
23. Construct the character table for C_{4v}.

Paper 104

Computer

1. What is compiler?
2. Divide (11001)₂ by (101)₂.
3. What is difference between a bit and byte?
4. In which generation Vaccum tube and transistor are used.
5. Write truth table of NAND gate and OR gate.
6. Differentiate between RAM and ROM.
7. Write a short note on either OCR or OMR
8. What are the two main components of CPU of a computer system?
9. Write the main function of each of these components.
10. What is Universal gate?
11. Design AND gate and OR gate using universal gate.
12. Write the truth table of Ex-OR gate an Ex-NOR gate
13. Differentiate between 'System Software' and 'Application software'
13. Differentiate between 'High level language' and 'Low level language'

Paper 104

Food Chemistry

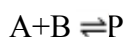
1. What is food?
2. Give example of two food preservatives.
3. What do you mean by 'food irradiation'?
4. What is food packaging?
5. What are the intrinsic and extrinsic factors for food spoilage?
6. Why is food preservation important? Are preservatives safe?
7. Write short note on 'Canning' or 'nutrition labeling'
8. What do you mean by salting and sugaring
9. What is food packaging?
10. What are the basic functions of food packing?
11. Write a short note on food packaging design and development?
12. What are the advantages of freeze drying over thermal drying?
13. Write the major differences between pasteurization and sterilization.

PG SEM - II

Physical Chemistry

Paper: CEM 201

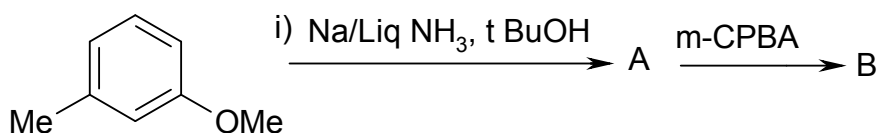
1. Show that ψ_0 and ψ_1 of a harmonic oscillator are orthogonal.
2. Prove that for a particle in one dimensional box moving freely $\psi_n = \sqrt{2/L} \sin n\pi x/L$ is not an eigen function of the operator x
3. Write two advantages of Raman Spectroscopy
4. What is difference between a clock reaction and an oscillatory reaction?
5. Give an example of enzyme Catalysed reaction stating the reactants and products.
6. What is Reverse Micelle?
7. Write the limitation of the Debye-Hukel theory for electrolytic solution.
8. "Anti stokes lines in Raman spectra are much less intense at room temperature than stokes lines" comment.
9. Wave function of a harmonic oscillator is an eigen function of the Hamiltonian operator.
10. Find out the total energy of the particle in the ground state (with $v=0$) and in the level $v=1$. Given $\psi_0 = (\alpha/4)^{1/4} e^{-\alpha x^2/2}$ $\psi_1 = (4\alpha^3/\pi)^{1/4} x e^{-\alpha x^2/2}$ where $\alpha = \sqrt{ku}$ and Find out the general expression of total energy in the v -th level
11. For CO molecule $I = 14.5695 \times 10^{-47} \text{ kg m}^2$. How many times the 3rd and 15th rotational levels are populated with respect to 2nd and 14th level respectively at 300K.
12. Calculate the Relaxation time for the chemical reaction



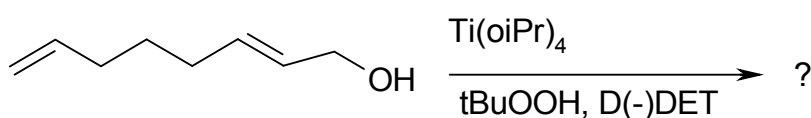
- Write the physical significance of activity coefficients.
- Write the usefulness of "Quenched flow" technique for the measurement of kinetics of fast chemical reaction.
- Write the summary of reaction sequence of Belousov-Zhabotinsky reaction
- Given that the spacing between the successive lines in a rotational spectrum of a diatomic molecules is 20 cm^{-1} . find the moment of inertia of the molecule?
- Derive the vibrational selection rules for Raman spectrum.

Paper: CEM 202
Organic Chemistry

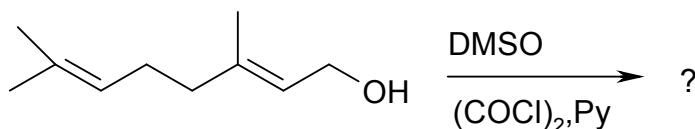
- Identify A and B of the following reaction



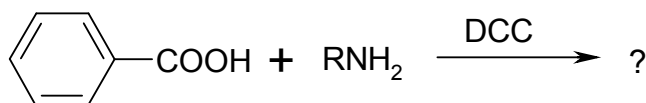
- Predict the product of the following reaction



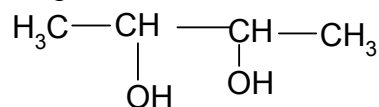
- Identify the product of the following reaction



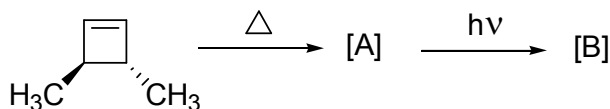
- Predict the product of the following reaction



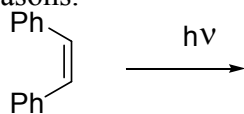
- Draw the most stable conformation of propene (w.r.t. C_1-C_2 bond) and explain stability.
- Draw the pref and praf conformation of the following molecule



- Why thermal [2+2]cycloaddition reaction does not take place?.
- Identify the products A & B in the following reactions.

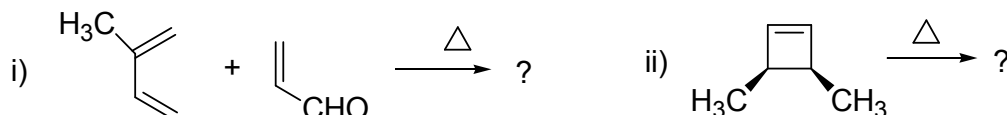


- 9) a) Write down the products in the following reaction and identify the major product with suitable reasons.

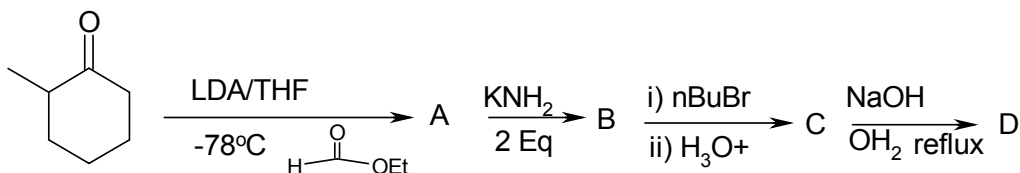


- b) What is periselectivity?

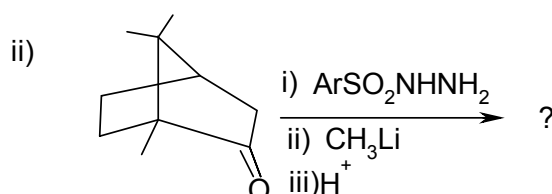
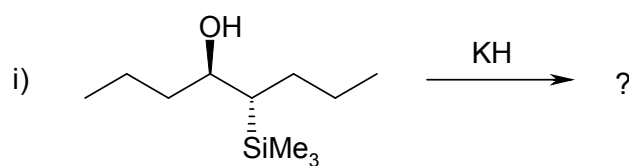
- 10) Predict the product(s) of the following reactions and explain the observed stereochemistry using FMO.



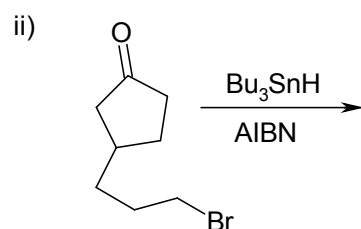
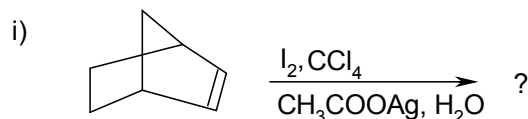
- 11) Identify the product A,B,C and D of the following conversion



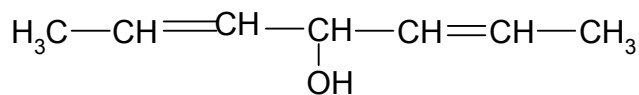
- 12) Predict the product of the following reaction with mechanism



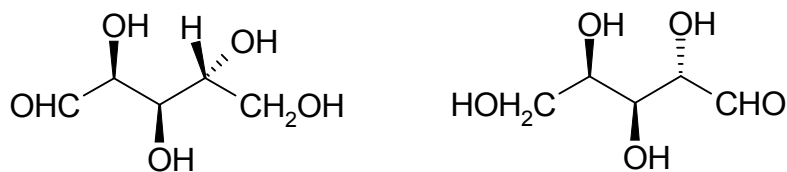
- 13) Predict the product of the following reaction



- 14) How many chiral centre are there in the following compound? How many stereoisomers are possible. Assign the R and S nomenclature

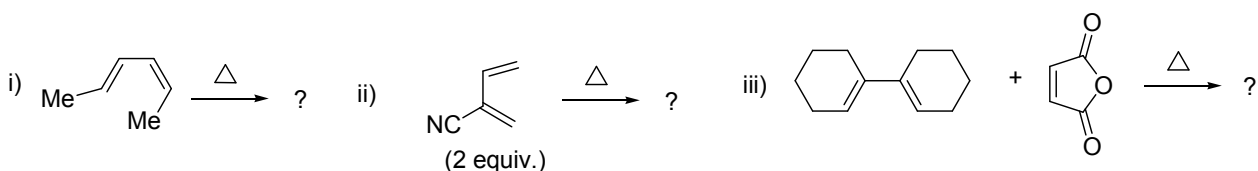


15) Find out stereoisomeric (Homomer/enantiomer/diastereomer) relationship of the following pair

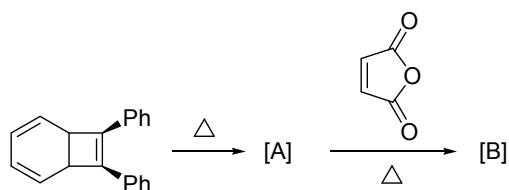


16) Explain with one example of your choice the famous sharpless epoxidation with mechanism.

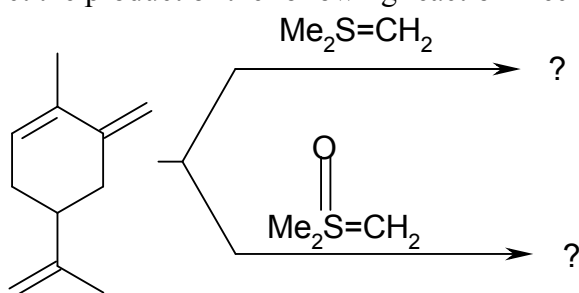
17) a) Predict the product (s) of the following reactions using FMO (answer any two).



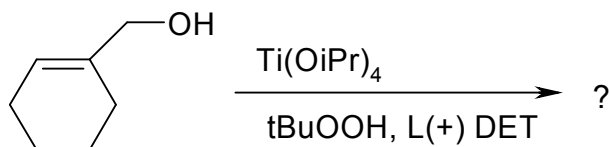
b) Identify product (s) A & B in the following reaction with suitable mechanisms (FMOs are not necessary).



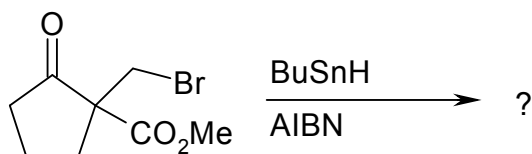
18) a) Predict the product of the following reaction mechanism



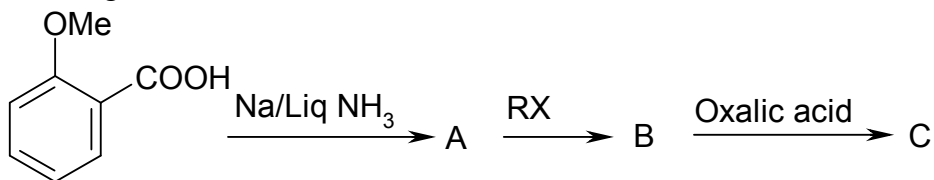
b) Predict the product of the following reaction mechanism.



c) Predict the product of the following reaction mechanism

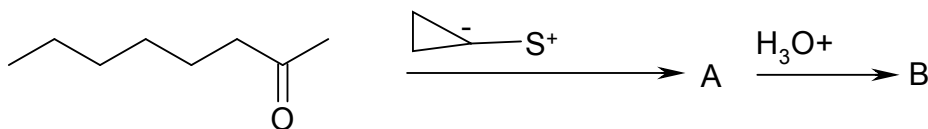


19) a) The following is the transformation:



Identify A, B and C. Write the mechanism

b) Identify the product A and B of the following reaction with mechanism.



20) Explain with example in each case

- Felkin Arh Model
- Cram's Model

Paper: CEM 203

Inorganic Chemistry

- What do you mean by BNCT?
- Identify products for the following reactions.

$$? \xleftarrow{\text{NH}_3} \text{B}_2\text{H}_6 \xrightarrow{\text{P}(\text{tBu})_3} ?$$
- Os₂I₈²⁻ have staggered configuration but Os₂Br₈²⁻ adopt eclipsed configuration- Explain.
- Show the d-orbitals splitting in [Mo(CN)₈]³⁻ complex.
- What is Projection operator?
- State the selection rules for the electric dipole transition of the fundamental vibrational modes of IR and Raman active molecule?
- Explain why polarization effect is not observed in cubic or higher symmetry molecule?
- What do you mean by agnostic interaction?

9. Write a short note on “Ruthenium di-nitrogen complexes”.
10. (a) Magnetic moment of $[(\text{NH}_3)_5\text{Cr}-\text{OH}-\text{Cr}(\text{NH}_3)_5]^{5+}$ is higher than that of $[(\text{NH}_3)_5\text{Cr}-\text{O}-\text{Cr}(\text{NH}_3)_5]^{4+}$ Explain.
 (b) How do you detect the trace amount of CrO_4^{2-} in $\text{Cr}_2\text{O}_7^{2-}$ solution?
11. (a) A borane molecule whose SYTX number is 4120 find out its formula and predict how many electron pair bond are there?
 (b) How will you synthesize B_2H_6 industrially?
12. How do you synthesize $\text{C}_2\text{H}_2\text{B}_{10}\text{H}_{10}$ from $\text{B}_{10}\text{H}_{14}$? Draw the structure of synthesized carborane molecule.
13. Find the symmetry of normal modes of vibrations in CH_2Cl_2 .
14. Find the M.O. diagram of H_2O molecule using projection operator technique .
15. Ground state of NO_2 is A_1 may be excited by the electric dipole transitions to what excited state and what transition of light is it necessary to be used?
16. Explain with MO diagram how 16 electron rule is important rather than 18 electron rule for square planer organometallic compounds ?
17. Prove that for HCHO molecule $n \rightarrow \pi^*$ transition is symmetry forbidden but $\pi \rightarrow \pi^*$ transition is symmetry allowed.
18. Show that $\delta \rightarrow \delta^*$ transition is electric dipole allowed for $[\text{Mo}_2\text{Cl}_8]^{4-}$ species and what polarisation of light is effective for the said purpose.
19. (a) Identify the core structure of the following specie on the basis of Wade’s rule; $\text{B}_{10}\text{H}_{14}$ and $(\eta^5\text{-C}_5\text{H}_5)\text{Co}(\text{C}_2\text{B}_9\text{H}_{11})$
 (b) Carry out the following transformation
 $1,2\text{-C}_2\text{B}_{10}\text{H}_{12} \longrightarrow (\text{HOOC})_2\text{C}_2\text{B}_{10}\text{H}_{10}$
 (c) Justify that $\text{C}_2\text{B}_9\text{H}_{11}^{2-}$ is more effective as a ligand than C_5H_5^- .
 (d) Draw the structure of B_4H_{10} and calculate its STYX number.
20. (a) Write down the synthesis and structure of a ‘polyoxovanadate’?
 (b) What happens when ZrCl_3 is treated with KNH_2 in liquid NH_3 .
 (c) How will you synthesize CrO_5 ?
 (d) How do you convert;
 (i) $\text{MnO}_4^- \longrightarrow \text{Mn}^{2+}$
 (ii) $\text{Mn}^{2+} \longrightarrow \text{MnO}_4^-$
 (e) Give the structural characteristics of ReH_9^{2-} ion ?

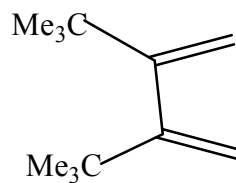
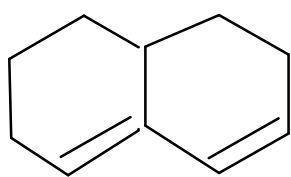
PG Semester III

Paper: CEM 301
(Inorganic Special)

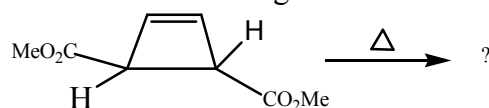
1. What it is necessary to record ESR spectra in first derivative plot?
2. Explain why water is not used as solvent for the ESR measurements?
3. What do you mean by “Kramer’s degeneracy”?
4. Write the name of two nuclei that show electric quadrupole moment.
5. Write down some properties of laser.
6. What is population inversion?
7. Define meta stable state of laser. What do you mean optical pumping?
8. Give some examples of solid, gas and semiconductor laser.
9. How many ESR lines are obtained for the following radicals.
 $[\text{CF}_2\text{H}]^\cdot$ $[\text{}^{13}\text{CF}_2\text{H}]^\cdot$ $[\text{CF}_2\text{D}]^\cdot$ $[\text{}^{13}\text{CF}_2\text{D}]^\cdot$
10. Why dpph is used as a standard in ESR studies? Calculate the ‘g’ value of methyl radical which shows ESR signal at 3290 gauss in a spectrophotometer operating frequency 9.4 GHz.
11. What do you mean by UPES and XPES?
12. Explain clearly the terms absorption, spontaneous emission and stimulated emission.
13. State burgers law. Derive its mathematical expression.
14. Write a short note on Ruby LASER
15. What is the disadvantages of three level LASER and how it was removed?
16. Write a short note on optical resonator.
17. Write a short note on Zero field splitting (b) For the $\cdot\text{NH}_2$ radical, if $a_{\text{H}} = x$ and $a_{\text{N}} = 2x$, how many lines appears in the ESR spectra and what will be their relative intensity ratio?
18. How many ESR lines are obtained for the following radicals.
 $[\text{Cu}(\text{NH}_3)_4]^{2+}$ MnO_4^-
19. How many ESR lines will be obtained for $\cdot\text{CH}_3$ radical (considering C atom is spin inactive) and also calculate the energy of each transition.
20. All paramagnetic substances are not EPR active but all EPR active substances are paramagnetic. Explain
 $2+3+3=8$
21. What do you mean by Einstein’s A, B coefficient? Show that the ratio
22. $\frac{A}{B} = \frac{8\pi h \nu^3}{c^3}$
23. Discuss He-Ne laser with working formula.

Paper: CEM 301
(Organic Special)

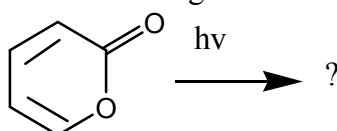
1. Define region selectivity.
2. Why Lewis acids increase the rate of a Diels- Alder reaction?
3. What is site selectivity?
4. Why are the following dienes not suitable for Diels- Alder reaction?



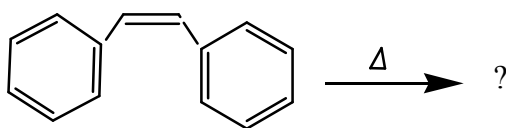
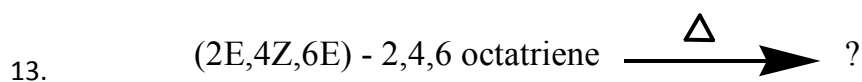
5. What is Hammett equation?
6. Predict the product of the following reaction indicating FMO interactions?



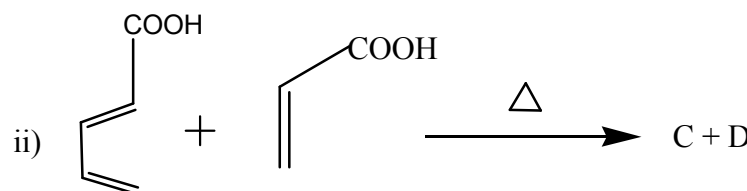
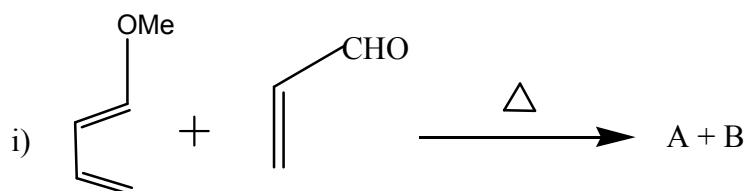
7. Transition metal complex exhibit special bonding-explain.
8. Predict the product of the following reaction.



9. “[1,3]-H migration is difficult to occur but [1,3] carbon migration occurs with inversion of configuration under thermal condition”. Justify the statement showing frontier orbitals.
10. What is cycloaddition reaction?
11. ii) What is mean by (i, j) shift in sigmatropic reactions? Explain with suitable example.
12. Predict the product of the following reaction with mechanism?



14. Identify the product A to D.

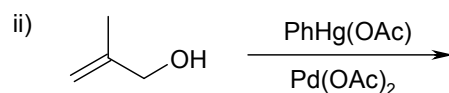
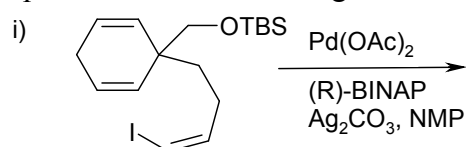


15. Show that linear free energy relationship (LFER) studies entail correlation of free energy changes associated with interactions of substituents and reaction centres of the reactants and products.

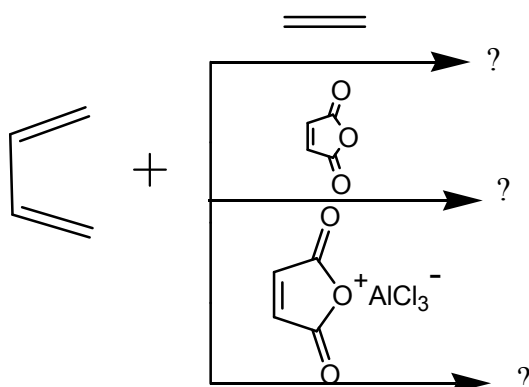
16. Define periselectivity with suitable example.

17. What is migratory insertion? Show a migratory insertion with reference to transition metal complex.

18. Predict the products of the following reaction

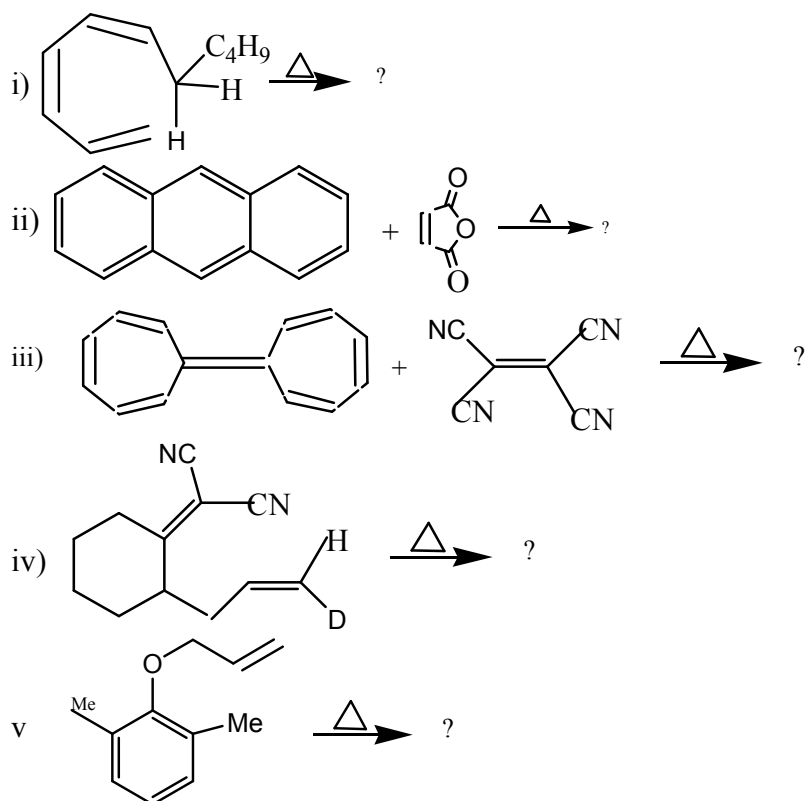


19. Predict the product and indicate the faster path of the following reaction under thermal condition.

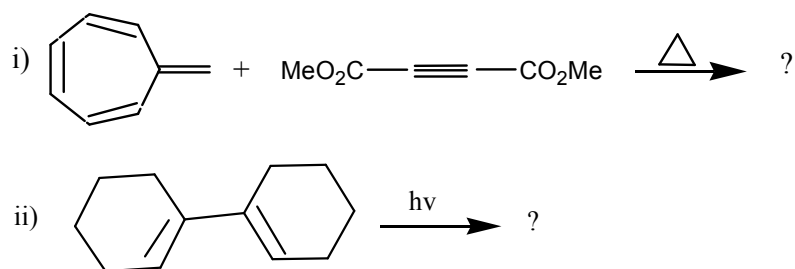


20. What is Cheletropic reaction? Give an example.

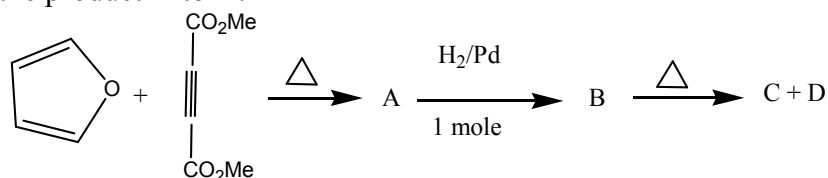
21. Predict the product of the following reaction with mechanism? (any four)



22. Predict the product (s) of the following reactions indicating FMO interactions?

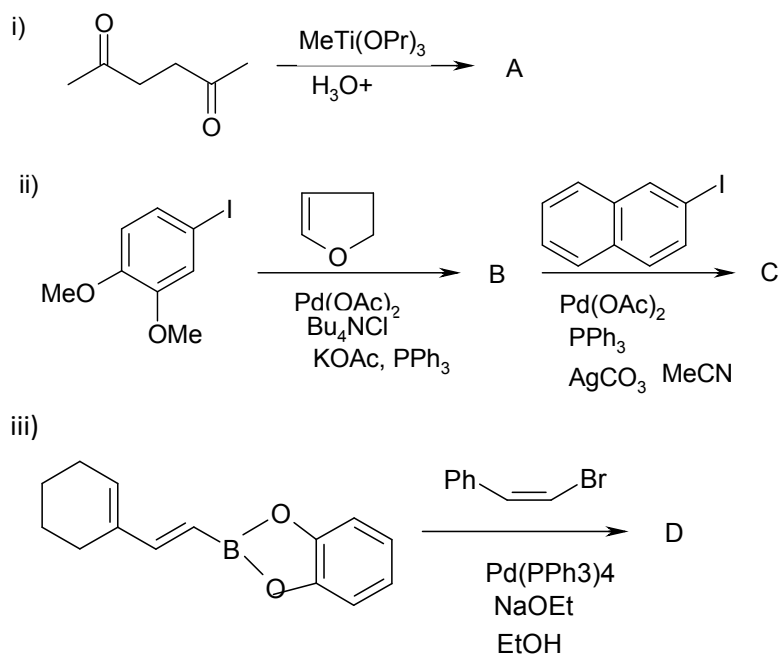


23. Identify the product A to D.



24. What is heptano number? Show the catalytic cycle of Suzuki coupling with oxidation states of the metal.

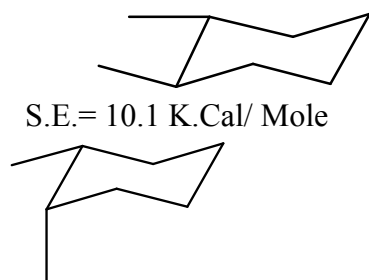
25. Write down the structure of the products (A-D) in the following reactions



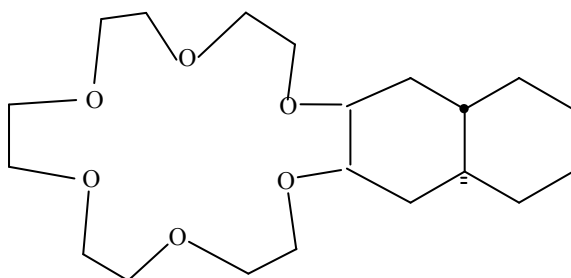
Paper: CEM 302
(Organic Special)

1. Define template effect.
2. What is molecular recognition?
3. What is π - π interaction?
4. What is green chemistry?
5. What is enzyme? Give example.
6. What is molecular mechanics calculation?
7. How does 18-crown-6 bind a monovalent cation?
8. What is peak selectivity?
9. What is self-assembly?
10. What are the driving forces for the self-assembly?
11. Show the green synthesis of the following compounds
 - a. Aspirin (under solvent free)
 - b. Adipic acid from cyclohexane
12. What are the principal forces involved in molecular recognition?
13. Write the applications of molecular recognition.
14. What is hydrophobic effect?
15. During crown ether synthesis, illustrate the role of metal ions.
16. Calculate the heat of formation of the following compounds.

S.E.= 8.5 K.Cal/ Mole



17. Name the compound and propose a synthetic route.

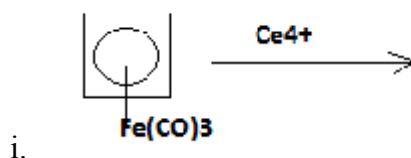


18. Give an example of Host- Guest complexation utilising aromatic- aromatic interactions.
19. What is cryptands?
20. How can one use cryptands in light conversion and energy transfer devices?
21. Write down the applications of crown ethers?
22. Define gels. How is it prepared?
23. Classify different types of gel.
24. Write some applications of supramolecular gels.
25. What are cyclodextrins?
26. Provide the name of different compounds which form complex with cyclodextrins.
27. Mention the major driving forces for the complexation between cyclodextrins and guest molecules.
28. Write the applications of cyclodextrins.
29. What is ionic liquid? Why ionic liquid is used as green solvent, Give one chemical reaction using ionic liquid.
30. How would you synthesize following compounds
 - a. Biodiesel from plant oil
 - b. Polylactic acid from corn

Paper: CEM 302
(Inorganic Special)

1. Why no polarization effect is observed for cubic or higher symmetry group?
2. What is 'vibronic coupling'?

- State the selection rules for the Raman active and IR active vibrational modes of molecule.
- Explain 'Hole formation'.
- State the postulates of DGM rule for polyene.
- Why cobaltocene is more reactive than ferrocene?
- Give one example where cyclopentadiene is bonded by η^1 , η^3 and η^5 simultaneously.
- Give the product of the following reaction



- Draw the Orgel diagram for $[V(H_2O)_6]^{3+}$ ion and state the possible electronic transition.
- Establish the formula

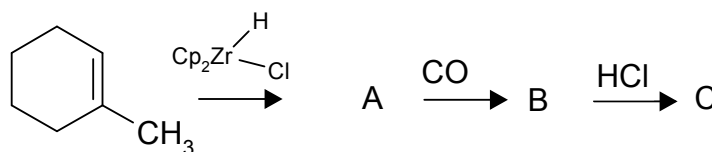
$$\chi(\alpha) = \frac{\sin(t+1/2)\alpha}{\sin\frac{\alpha}{2}}$$

Where symbols have their usual significances

- What is projection operator? Find the LGO's of NH_3 molecule using projection operator technique
- Find the IR and Raman active mode of NH_3 molecule. Character table for C_{3v} is given below

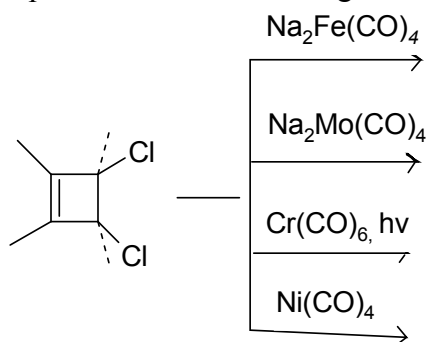
13. C_{3v}	14. E $2C_3$ $3\sigma_v$	15.	16.
17.	21.	25.	27.
18. A_1	22. 1 1	a. Z	28. x^2+y^2, z^2
19. A_2	1	b. R_z	
20. E	23. 1 1 -1	26. (x,y) (R_x, R_y)	29. (x^2-y^2, xy) (xz,yz)
	24. 2 -1 0		

- What is Schwartz's Reagent? Identify A, B and C from the following reaction



- What is the actual shape of cyclobutadiene in the metal complex? Explain.
- How ferrocene is synthesized? Give the stable structure of ferrocene.

33. Write the products of the following reactions



34. Find the SALCs for π molecular orbital of cyclopropenyl cation using projection operators and explain its magnetic properties

D_{3h}	E	$2C_3$	$3C_2$	σ_h	$2S_3$	$3\sigma_v$		
A_1'	1	1	1	1	1	1		$x^2 + y^2, z^2$
A_2'	1	1	-1	1	1	-1	R_z	
E'	2	-1	0	2	-1	0	(x, y)	$(x^2 - y^2, xy)$
A_1''	1	1	1	-1	-1	-1		
A_2''	1	1	-1	-1	-1	1	z	
E''	2	-1	0	-2	1	0	(R_x, R_y)	(xz, yz)

35. Draw the correlation diagram for d^2 configuration in octahedral field. Character table of O_h group is given below.

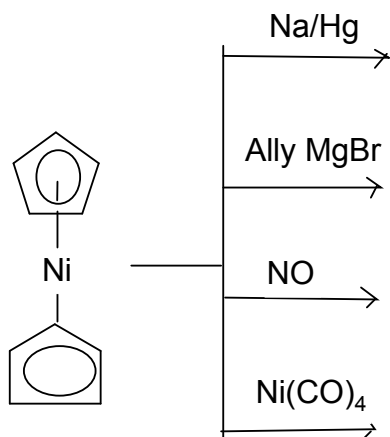
O_h ($m\bar{3}m$)	E	$8C_3$	$6C_2$	$6C_4$	$3C_2$ ($=C_4^2$)	i	$6S_4$	$8S_6$	$3\sigma_h$	$6\sigma_d$	
A_{1g}	1	1	1	1	1	1	1	1	1	1	$x^2 + y^2 + z^2$
A_{2g}	1	1	-1	-1	1	1	-1	1	1	-1	
E_g	2	-1	0	0	2	2	0	-1	2	0	$(2z^2 - x^2 - y^2, \sqrt{3}(x^2 - y^2))$
T_{1g}	3	0	-1	1	-1	3	1	0	-1	-1	(R_x, R_y, R_z)
T_{2g}	3	0	1	-1	-1	3	-1	0	-1	1	(xy, xz, yz)
A_{1u}	1	1	1	1	1	-1	-1	-1	-1	-1	
A_{2u}	1	1	-1	-1	1	-1	1	-1	-1	1	
E_u	2	-1	0	0	2	-2	0	1	-2	0	
T_{1u}	3	0	-1	1	-1	-3	-1	0	1	1	(x, y, z)
T_{2u}	3	0	1	-1	-1	-3	1	0	1	-1	

36. Describe the stability and reactivity of ferrocene using MO diagram.

37. How triple decer nickel complex is synthesized?

38. Give an example of η^5 -milking tool complex and η^6 piano tool complex.

39. Write the products of the following reactions.



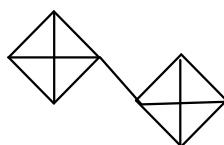
Paper: CEM 302
(Inorganic Special)

1. What is replication of DNA?
2. What is the function of catalase.
3. Write the role of Vitamin B₁₂ in human body?
4. What do you mean by delayed fluorescence?
5. Give one example of Vanadium containing protein. State its main function?
6. Give two application of photochemical process.
7. Write the main function of nitrate reductase.
8. What is the functional difference between catalase and peroxidase?
9. What is nitrogenase? What is its biological function?
10. What is cytochrome P-450? How do you justify its name? Discuss its structural properties.
11. What is superoxide dismutase? What are the metal ions involved in it?
12. What is THEXI & DOSENCO state?
13. What is sulfite oxidase? Discuss its mechanism of activity.
14. How Cis-platine interact with DNA in gene therapy
15. What is photoluminescence? Give two application of its.
16. What do you mean by chemiluminescence process. State the conditions for a reaction to be chemiluminiscent.
17. Describe the structural features of chlorophyll. How does the chlorine ring differ from porphyrin ring
18. Discuss the structure and biologibal function of Vitamin B₁₂.
19. Using Jablonski diagram state and explain the florescence and phosphoresces.
20. Explain the kinetics of excitation process. Find out Stern-Volmer constant for excited state quenching process.

PG Semester IV

Paper: CEM 401 (Inorganic Special)

1. What is Lande Interval Rule?
2. Calculate the magnetic moment of Gd^{3+} ?
3. What do you mean by “magnetic triplet” and “non-magnetic doublet”?
4. Define “zero-field splitting”
5. What is TIP? When does it arise?
6. How will you synthesise $Cr(CO)_6$ by reductive carbonylation process?
7. What is the metal framework geometry of $Os_6(CO)_{18}$ cluster?
8. Substitution of two CO ligands in $Fe_2(CO)_9$ by 2-2'-bipy leads to considerable change in structure in the bridging region – Illustrate the statement by drawing their structure.
9. a) The metal core structure of $Ir_8(CO)_{22}]^{2-}$ is



- What would be the appropriate electron counting scheme for the cluster?
- b) What happens when $Fe(CO)_5$ is allowed to react with I_2 ?
10. a) $Os_5(CO)_{18}$ has a raft structure. Is this consistent with the number of valence electron available?
b) Why $V(CO)_6$ does not dimerise although it is 17 e species?
 11. What is anti ferromagnetic? Describe the different exchange path way that are responsible for anti-ferromagnetism.
 12. Describe the basic differences between the magnetic property of 3d metal ion with these of the lanthanides
 13. From the following magnetic data explain the trends

Complex	μ (BM)
$Cu_2(CH_3COOH)_2 \cdot 2H_2O$	1.39
$Cu_2(ClCH_2COOH)_2 \cdot 2H_2O$	1.42
$Cu_2(Cl_2CHCOOH)_2 \cdot 2H_2O$	1.66
$Cu_2(Cl_3C.COOH)_2 \cdot 2H_2O$	1.77
$Cu_2(F_3C.COOH)_2 \cdot 2H_2O$	1.90

14. Between $[(NH_3)_5-Cr-O-Cr-(NH_3)_5] Br_4$ and $[(NH_3)_5-Cr-OH-Cr-(NH_3)_5] Br_4$ which one will have lower μ_{expt} and why?
15. What is spin-orbit coupling constant? What is its significance?

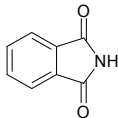
16. What is multiple width and find the limitation of Curie Law?
17. Derive the magnetic moment equation for a system usual multiplet width is small compact to KT .
18. Deduce Curie Law for paramagnetism based on Langevin's theory.
19. a) What is Collman's reagent? How do you synthesize it from $\text{Fe}(\text{CO})_5$.
 b) Synthesize RH and RCOOH from $\text{Na}_2[\text{Fe}(\text{CO})_4]$
 c) Explain the $\nu_{\text{C-O}}$ stretching frequency of the following carbonyls.

Metal carbonyl	$\nu_{\text{C-O}}$ stretching (cm^{-1})
$\text{Ti}(\text{CO})_6^{2-}$	1748
$\text{V}(\text{CO})_6^-$	1859
$\text{Cr}(\text{CO})_6$	2000
$\text{Mn}(\text{CO})_6^+$	2100
$\text{Fe}(\text{CO})_6^{2+}$	2204
Free CO	2143

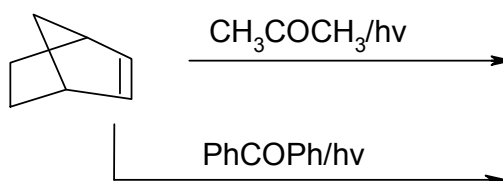
20. a) In $\text{Sm}(\text{III})$ and $\text{Eu}(\text{III})$, μ_{expt} are greater than μ_{J} values why?
 b) Write the relation between molar magnetic susceptibility with temperature and draw a plot for paramagnetic substance.

Paper: CEM 401 (Organic Special)

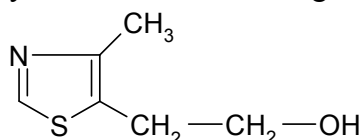
- What is Quenching reaction? Give example.
- What is Paterno-Buchi addition reaction? Give example.
- What is sensitization reaction? Give example.
- Arrange the basicity with explanations of oxazole, thiazole and imidazole?
- How can you prepare 3-nitro pyrrole?
- What are vitamins? What are the function of vitamin B_1 and C ?
- Define co-enzymes and holoenzymes.
- Write down the chemical structure of cephalosporin C and streptomycin.
- Write all the steps for the synthesis of Penicillin V from


- Show how, coenzymes of Vitamin B_1 takes part in decarboxylation of pyruvic acid, the end product of the carbohydrate metabolism and depict the chemical reaction involved therein.
- Give the structure of uric acid. Give the product when o-nitrotoluene is treated with benzaldehyde in presence of base followed by the use of $\text{P}(\text{OEt})_3$.

12. Give the product(s) with explanation when pyridine N-oxide and 2,4-dimethyl pyridine N-oxide are separately treated with acetic anhydride
13. What is purine. How can you prepare tryptophan from indole?
14. Predict the products for the following reaction



15. Define Norrish type-I and type –II reactions. Explain each of these reactions with suitable mechanism.
16. How antibiotic show their activity? When penicillian does not show antibacterial activity.
17. a) Give the product(s) with explanation when pyrrole, furan and N-acetyl pyrrole are separately treated with maleic anhydride?
 b) Give the product(s) with explanation when 2-brobo 3-aryl furan and methyl acrylate are separately treated with in presence of
 i) Pd(II)cat, Cu(II), DMF, air, heat
 ii) Pd(0) cat, inert atm, DMF, heat.
18. a) Write all the steps for the synthesis of the following compounds.



- b) Discuss the mode of action of the co-enzyme derived from Riboflavin.

Paper: CEM 402 (Inorganic Special)

- 1) What do you mean by Spectrator ligand? Give an example.
- 2) Predict the products of following reaction (1 mol of each reactant):
 i) $[\text{Pt}(\text{CO})\text{Cl}_3]^- + \text{NH}_3 \longrightarrow ?$
 ii) $[\text{Pt}(\text{NH}_3)\text{Br}_3]^- + \text{NH}_3 \longrightarrow ?$
- 3) Arrange the following in order of increasing rate of water exchange with explanation:
 $[\text{V}(\text{H}_2\text{O})_6]^{2+}$, $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$, $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Mg}(\text{H}_2\text{O})_6]^{2+}$
- 4) Write down the name of one physical and one chemical technique to distinguish the geometrical isomers.
- 5) Write D lkovie equation stating the terms involved.

- 6) What is polarographic maxima? How do you eliminate this problem?
- 7) What is cyclic voltametry? Why it is called?
- 8) State the factors affecting TGA.
- 9) What do you mean by 'trans effect'? How will you synthesize the *cis* and *trans* isomer of $[\text{PtCl}_2(\text{C}_2\text{H}_4)(\text{NH}_3)]$ starting from $[\text{PtCl}_4]^{2-}$?
- 10) The racemization of $[\text{Co}(\text{bigH})_3]^{3+}$ (big H = Biguanide) and *cis*- $[\text{Co}(\text{trien})\text{Cl}_2]$ (trien = triethylenetetraamine) follow the different twist mechanism? Show the mechanisms of racemization for these two complexes and explain the statement.
- 11) Explain D-Mechanism and A-Mechanism of the substitution in octahedral complexes.
- 12) When $[\text{Co}(\text{NH}_3)_5\text{SCN}]^{2+}$ reacts with $[\text{Cr}(\text{OH}_2)_6]^{2+}$ both $[\text{SCN}-\text{Cr}(\text{OH}_2)_5]^{2+}$ and $[\text{NCS}-\text{Cr}(\text{OH}_2)_5]^{2+}$ are produced. It has been postulated that both remote and adjacent attacks are involved in the formation of these products. Draw bridging intermediates consistent with the view for the formation of both products.
- 13) Write the basic principle of polarography. Why limiting current curve runs parallel to voltage axis?
- 14) Deduce the relationship between half-wave potential and standard redox potential of a system.
- 15) Discuss redox titration and acid base titration one each by coulometric method.
- 16) How will you detect the oxidation and reduction by a cyclic voltammetric curve?
- 17) Write a short note on "Outer sphere mechanism".
- 18) Give two examples of electron transfer metalloprotein.
- 19) A divalent metal ion forms octahedral complexes with a neutral bidentate ligand. Write down the complex formation equilibrium in aqueous solution. Give expression for stepwise and overall stability constants and show relation among them.
- 20) What do mean by DTA? Illustrate with an example the complementary relationship of TGA and STA.
- 21) How stability constant (β) of a complex can be determined by polarographic method?