GEOLOGIST EXAMINATION-2014
GENERAL ENGLISH

Time Allowed : Three Hours **M.M. : 100**

INSTRUCTIONS

- **Please reach each of the following instruction carefully before attempting questions:**
- There are six questions and all are to be attempted.
- The number of marks carried by a question/part is indicated against it.
- Answers must be written in ENGLISH only.
- Candidates are required to write clear, legible and concise answer and to adhere to word limits wherever indicated. Failure to adhere to word limits may be penalized.
- Precis question must be attempted only on the special precis sheet(s) provided. These precis sheets must be attached securely to the answer book.
- All parts and sub-parts of a question are to be attempted together in the answer book.
- You must not disclose your identity in any of your answer.

1. Write an essay on any *one* of the following topics in not less than 800 words : **[30]**
   (a) Use of Social Mediain Politics (b) Impact of FDI in Retailon Agriculture
   (c) Eco-tourism and challenges it faces (d) Diversification of Crops and Chemical Pollution
   (e) Genetic Engineering-Prospects and Hazards

2. Make a precis of each of the following two passage in about one-third of the original length, using your own words : **[20+10=30]**
   (Note : The precis must be written only on the special sheets provided for the purpose, writing one word in each block. The sheet should be fastened securely inside the answer book).

   (a) Let us first consider what state of things is described by the word "civilization". Its true test lies in the fact that people living in it make bodily welfare the object of life. We will take some examples. Formerly, only a few men wrote valuable books. Now, any body writes and prints any thing helikes and·poisons people's minds. Formerly, men travelled in wagons. Now,they fly through the air in trains at the rate off our hundred and more miles per day. This is considered the height of civilization. It has been stated that, as men progress, they shall be able to travel in airships and reach any part of the world in a few hours. Men will not need the use of their hand sand feet. They will press a button, and they will have their clothing by their side. They will press another button, and they will have their newspaper. A third, and a motorcar will be in waiting for them. They will have a variety of delicately dished up food. Every thing will be done by machinery. Formerly, when people wanted to fight with one another, they measured between them their bodily strength; now it is possible to take away thousands of lives by one man working behind a gun from a hill. This is civilization. Formerly, men worked in the open air only as much as they liked. Now thousands of work men meet together and for the sake of maintenance work in factories or mines. Their condition is worse than that of beasts. They are obliged to work, at the risk of their lives; atmost dangerous occupations, for the

sake of millionaires. Formerly, men were made slaves under physical compulsion. Now they are enslaved by temptation of money and of the luxuries that money can buy. There are now diseases of which people never dreamt before, and an army of doctors is engaged in finding out their cures, and so hospital shave increased. This is a test of civilization. Formerly, special messengers were required and much expense was incurred in order to send letters; today, any one can abuse his fellow by means of a letter for one penny. True, at the same cost, one can send one's thanks also. Formerly, people had two or three meals consisting of homemade bread and vegetables; now, they require something to eat every two hours so that they have hardly leisure for any thing else. What more need I say' ? All this you can as certain from several authoritative books. These are all true tests of civilization. And if any one speaks to the contrary, know that he is ignorant. This civilization takes note neither of morality nor of religion. Its votaries calmly state that their business is not to teach religion. Some even consider it to be a superstitious growth. Others put on the cloak of religion, and prate about morality. But, after twenty years' experience, I have come to the conclusion that immorality is often taught in the name of morality. Even a child can understand that in all I have described above there can be no inducement to morality. Civilization seeks to increase bodily comforts, and it fails miserably even in doing so.

This civilization is such that one has on1y to be patient and it will be self-destroyed. According to the teaching of Mohammed this would be considered a Satanic Civilization. Hinduism call sita Black Age. I cannot give you an adequate conception of it. It is eating into the vitals of the English nation. It must be shunned. Parliaments are really emblems of slavery. If you will sufficiently think over this, you will entertain the same opinion and cease to blame the English. They rather deserve our sympathy. They are a shrewd.nation and I therefore believe that they will cast off the evil. They are enter prising and industrious, and their mode of thought is not inherently immoral. Neither are they bad at heart. I therefore respect them. Civilization is not an incurable disease, but it should never be forgotten that the English are at present afflicted by it.

(b) The real implication of equal distribution is that each man shall have the wherewithal to supply all his natural need sand no more. For example, if one man has a weak digestion and requires only a quarter of a pound of flour for his bread and another needs a pound, both should be in a position to satisfy their wants. To bring this ideal into being the entire social order has got to be reconstructed. A society based on non-violence cannot nurture any other ideal. We may not perhaps be able to realize the goal, but we must bear it in mind and work unceasingly to go near it. To the same extent as we progress towards our goal we shall find contentment and happiness, and to that extent too shall we have contributed towards the bringing into being of a non-violet society.

It is perfectly possible for an individual to adopt this way of life without having to wait for others to do so. And if an individual can observe a certain rule of conduct, it follows that a group of individuals can do likewise. It is necessary for me to emphasize the fact that no one need wait for anyone else in order to adopt a right course. Men generally hesitate to make a beginning if they feel that the objective cannot be had in its entirety. Such an attitude of minds is in reality a bar to progress.

Now let us consider how equal distribution can be brought about through non-violence. The first step towards it is for him who has made this ideal part of his being to bring about the necessary changes in his personal life. He would reduce his wants to a minimum, bearing in mind the poverty of India.

3. Write a paragraph in about 200 words on any *one* of the following phrases/expressions: **[10]**

(a) Two wrongs don't make a right. (b) The pen is mighter than the sword.

(c) When in Rome, do as the Romans do. (d) No man is an island.

(e) Fortune favours the bold.

4. Use the following words in sentences so as to bring out their meaning clearly. Do not change the form of the word. No credit will be given for a vague or ambiguous sentence. **[2×5=10]**

(a) Quagmire (b) Remuneration (c) Penchant (d) Verbiage (e) Niche

5. Make the directed changes in the following sentences without changing their meaning : **[2×5=10]**

(a) He said, "I have passed the examination". (Change into indirect speech)

(b) I have a piece of bread please ? (Use the modal auxilary May or Might)

(c) Our generations is modern. (Use the superlative)

(d) John Lennon died while he lived in New York. (Progressive or Continuous forms)

(e) Germany invaded Poland in 1939, thus initiating the Second World War. (Changing into passive voice)

6. Correct the following sentences without changing their meaning. Do not make unnecessary changes in the original sentence. **[1×10=10]**

(a) I would rathar die than begging alms.

(b) Neither of the five players was selected.

(c) The fisherman held several fish from the sea.

(d) I asked him that how many brothers had he.

(e) He cannot dare to come here.

(f) This is the man which killed his father.

(g) No scannar had she arrived when the telegram came.

(h) John is a tall boy, isn't it ?

(i) They have disposed off their farm house.

(j) My hand writing is superior than any of yours.

Geo-Scientist Paper 2014

Paper-I

SECTION-A

1. Answer all of the following: **5×10 = 50**

(a) Discuss the radius ratio rule for predicting structure of ionic crystals. **[5]**

(b) Discuss the effect of solvent on relative strengths of acids and bases **[5]**

(c) How do you account for the following disproportional reaction? **[5]**

$$Cu(I) \rightarrow Cu(II) + Cu(s)$$

(d) Explain why square planar Ni(II) organometallic complexes are stable though they do not obey the 18-electron rule. **[5]**

(e) What do you mean by packing fraction? Explain how it indicates stability of elements. **[5]**

(f) Lithium has the highest ionization potential among alkali metals, yet it is the most powerful reducing agent. Explain. **[5]**

(g) Describe the structures of ClO_3^- and ClO_4^- ions on the basis of concept of hybridization **[5]**

(h) What are the important consequences of lanthanide contraction? **[5]**

(i) Apply the concept of EAN rule on $\left[Fe(CN)_6\right]^{4-}$ and $\left[Fe(CN)_6\right]^{3-}$ complexes and find out its validity to these complexes **[5]**

(j) Explain the Hund's rule and determine the ground state terms for Fe^{2+}, Ni^{2+}, Ti^{2+}, Mn^{2+} and V^{3+} (At No. for Fe, Ni, Ti, Mn and V are 26, 28, 22, 25 and 23) **[5]**

SECTION-B

Attempt any ONE question:

2. (a) the radius of a cation is invariably smaller and that of an anion is invariably larger than that of corresponding atom. Justify with examples. **[10]**

(b) with the help of molecular orbital diagram, explain why **[10]**

(i) the bond order in N_2^+ ion is less than that in N_2 molecule, whereas the bond order in O_2^+ ion is greater than that in O_2 molecule;

(ii) the bond energy of NO^+ is higher than that of NO.

(c) discuss electronegativity according to Pauling's approach and Mulliken's approach. **[10]**

3. (a) Explain the cause of recurrence of properties of elements at regular interval of atomic numbers, with suitable examples. **[10]**

(b) Explain how atomic orbitals combine to form bonding and anti-bonding molecular orbitals. What are the limiations to such combinations? **[10]**

(c) Discuss the factors influencing electronegativity. **[10]**

SECTION-C

4. **Attempt any ONE question:**

(a) Define hard and soft acids and bases

What is HSAB principle? Explain why

(i) AgI_2^- complex is stable, but AgF_2^- is not;

(ii) $\left[Co(NH_3)_5F\right]^{2+}$ is stable, while $\left[Co(NH_3)_5I\right]^{2+}$ is unstable.

(iii) CsF reacts with LiI to give LiF and CsI. **[15]**

(b) (i) Explain briefly the term ' electrode potential'. Derive an expression for calculating Ecell for galvanic cell.

(ii) Cr(II) is strongly reducing, but Mn(III) is strongly oxidizing. Explain why

Given : $E^0_{Mn^{3+}/Mn} = +1.51V$

$E^0_{Cr^{2+}/Cr} = -0.41V$

5. (a) What is pK_a value of a weak acid? Derive its relationship with pH of the weak acid. **[15]**

(b) Explain the term 'solubility product' and 'common ion effect', and their role in qualitative analysis of metal ions. **[15]**

SECTION-D

Attempt any **ONE** question.

6. (a) Describe various reactions of ferrocene which establish its aromatic character. How is the aromaticity of ferrocene more than that of benzene? **[15]**

(b) Explain briefly the theory of nuclear fission reaction. Which of U^{235} or U^{238} is easily fissinable with thermal neutrons? Give reasons. **[15]**

7. (a) Draw and discuss the structures of the following **[15]**

(i) $Fe_3(CO)_{12}$ (ii) $[Re_2Cl_8]^{2-}$

(b) Explain briefly the theory of neutron activation analysis. How is it used for the determination of an element in a sample? **[15]**

SECTION-E

8. Attempt any **ONE** question.

(a) Draw the complexes formed by Li^+ and Na^+ with salicylaldehyde and with acetylacetone. Why do the coordination numbers differ? **[15]**

(b) What are metal carbonyls? Discuss the methods of preparation, properties and structures of some typical metal carbonyls. **[15]**

9. (a) Describe one method of preparation and structure of each of the following: **[15]**

(i) ClF_3 (ii) $HClO_4$ (iii) I_2O_5 (iv) OF_2 (v) IF_5

(b) (i) What are silicones? How are these synthesized? Discuss their structures, properties and uses. **[15]**

(ii) CO_2 is a gas, but SiO_2 is a highly stable solid. Explain.

SECTION-F

Attempt any **ONE** question.

10. (a) (i) What are the various oxidation states of vanadium? How would you account for them?

(ii) The magnetic moment of $[Mn(CN)_6]^{3-}$ is 2.8 BM, while the magnetic moment of $[MnBr_4]^{2-}$ is 5.9 BM. What are the geometries of the complex ions?

(iii) Explain why Pt(II) and Pd(II) form square planar complexes almost exclusively but only a few Ni(II) complexes are known. **[15]**

(b) What is Jahn-Teller theorem? Describe symmetrical and unsymmetrical t_{2g} and e_g orbitals. Discuss the conditions for no distortion, slight distortion and strong distortion. **[15]**

11. (a) Give the general electronic configuration of lanthanide. Explain **[15]**

(i) the filling of 4f sub-shell in the lanthanide series

(ii) the anomalous oxidation states of +2 and +4 shown by some elements in the series

(iii) the problems in the separation of lanthanides from one another.

(b) (i) write the formula for the complex dichlorobis (ethylenediamine) cobalt (III) ion. Draw its geometrical and optical isomers.

(ii) Write the IUPAC names for $Hg[Co(NCS)_4]$ and $[Pt(NH_3)_4(NO_2)(Cl)]SO_4$ **[15]**

Paper-II

SECTION-A

1. Answer all of the following: **5×16 = 80**

(a) Calculate most probable velocity of CO_2 molecule at 0ºC.

(b) Show that for van der Waal's gas $\frac{RT_c}{P_c V_c} = 8$

(T_c, P_c and V_c represent critical constants)

(c) Calculate the work done in blowing a soap bubble in air of radius of 10 cm. Surface tension of soap solution is 30×10^{-3} Nm^{-1}.

(d) State Le Chatelier's princple and apply it to discuss the optimum conditions for the manufacture of ammonia

$$\left[N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} + 92kJmol^{-1} \right]$$

(e) Show that work done in a reversible process is greater than the work done in an irreversible process

(f) A first order reaction is 40% complete in 10 minute. What is the percentage of the reactant left after 1 hour?

(g) 50 ml of 0.1M acetic acid is mixed with 50 mL of 0.1M sodium acetate. What is the pH of the resultant solution? pK_a of acetic acid is 4.76.

(h) The osmotic pressure of human blood in the presence of various solutes is 7.65 atmospheres. What is the total concentration of various solutes in blood?

(i) Enthalpy of adsorption is a function of surface coverage. Justify the statement

(j) The molar conductance at infinite dilution of NaOH, NaCl and $BaCl_2$ are 248.1×10^{-4}, 126.5×10^{-4} and 280.0×10^{-4} S m^2 mol^{-1}. Calculate the molar conductance at infinite dilution for $Ba(OH)_2$.

(k) The microwave spectrum of HF consists of a series of absorption bands, whereas its infrared spectrum has only a single band. Discuss the reasons for the difference in the features of a microwave spectrum compared to an infrared spectrum for a diatomic molecule using HF as an example.

(l) When light of 400 nm wavelength strikes the surface of calcium metal, electrons having a kinetic energy of 6.3×10^{-20} J are emitted. Calculate the binding energy of the electrons in calcium and the minimum frequency required to elicit this photoelectric effect.

(m) Calculate the de-Broglie wavelength of

(i) an electron moving at 100 km s^{-1}.

(ii) a 0.010 kg bird moving at 100 ms^{-1}.

(n) The Bohr model for atomic hydrogen predicts that the energies of allowed orbitals are given by

$E_n = -2.178\times10^{-18/n^2}$ joule, where $n = 1, 2, 3, ...\infty$

(i) The Paschen series involves transitions down to the n = 3 level. Calculate the expected wavelength in nanometer of a line in the spectrum of atomic hydrogen associated with a transition of this type from the n = 10 orbit to the n = 3 orbit.

(ii) Is this line in the UV, visible or infrared region of the electromagnetic spectrum?

(o) The most probable electronic transition for a particular diatomic molecule is from $v'' = 0$ to $v' = 6$. The double prime indicates the molecule is in its ground electronic state, while the single prime indicates the molecule is in an electronic excited state.

Sketch potential energy curves, including vibrational energy levels, illustrating the fluorescence decay of the molecule from the electronic excited state down to the electronic ground state

(p) Describe, in quantum mechanical terms, why electronic absorption and emission spectra consist of broad band peaks.

SECTION-B

Attempt any SIX question: Each question carries 10 marks. **6×10 = 60**

2. Write Maxwell's distribution of molecular velocities of gases. What is the effect of temperature on the distribution? Represent graphically. Discuss the important features.

3. The first order reflection from a crystal plane in a cubic crystal occurs at $13^{o}\,41'$. Find the miller indices of the plane. [$a = 5.63\text{Å}, \lambda = 1.54\text{Å}, \sin^2(13^{o}\,41') = 0.0561$]

4. (a) Explain what you mean by chemical potential. How would you represent chemical potential in terms of G, H, A and U? **[5]**

   (b) Deduce the equation of van't Hoff reaction isotherm for the reaction **[5]**

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

5. 0.01 M solution of aqueous NH_4Cl is prepared at 25ºC. $K_b = 1.81\times10^{-5}$, $K_w = 10^{-14}$. Calculate the pH of the solution.

6. The rate constant of a first order reaction is given by $K_1 = 5\times10^{13}e^{-\frac{(1000000)}{RT}}$. Find enthalpy and entropy of activation at 300K. Energy is given in Joules.

7. The Schrodinger equation for a particle in a box is

   $$-\frac{\hbar^2}{2m}\frac{d^2\psi(x)}{dx^2} = E\psi(x)$$

   (a) Show that $\psi(x) = \sqrt{\frac{2}{L}}\sin\frac{n\pi x}{L};\ n = 1, 2, 3, ...$ **[5]**

   are wavefunctions that satisfy the boundary conditions $(\psi(x) = 0$ at $x = 0$ and $x = L)$

   (b) Show that the energy level are given by **[3]**

   $$E_n = \frac{n^2h^2}{8mL^2}$$

   (c) Derive an expression for minimum uncertainty in momentum Δp_x for an electron in a cubic box of length L. **[4]**

8. The overall all quantum yield for the photochemical decomposition of a dye is 0.5 at a wavelength of irradiation of 300 nm. Using a 100 W light source at 300 nm, how long (in min) will it take to photodecompose 1.0 mol of the dye under conditions of total light absorption?

9. (a) What is the difference between the fluorescence lifetime and the radiative lifetime of a fluorescent compound? **[2]**

   (b) Discuss the molecular orbitals and the various electronic transitions possible in formaldehyde, CH_2O. Draw an appropriate energy level diagram displaying these transitions. **[8]**

SECTION-C

Attempt any THREE question: Each question carries 20 marks.

10. (a) State Carnot's theorem and deduce the expression for the efficiency of an ideal heat engine. State the criteria for spontaneity of a process and discuss the change of enthalpy and entropy for the feasibility of a spontaneous process. **[10]**

    (b) Deduce the relation **[5]**

    $$C_P - C_V = \left[V - \left(\frac{\partial H}{\partial P}\right)_T\right]\left(\frac{\partial P}{\partial T}\right)_V$$

    (c) Calculate the minimum amount of work in Joules required to freeze 1g of water at 0ºC by means of a refrigerator which operates in a surroundings at 25ºC. How much heat is given to the surroundings?

    (Given that latent heat of fusion of water is 6.03 kJ mol^{-1}). **[5]**

11. Derive an equation to show the effect of ionic strength of the medium on the rate of ionic reactions in solution.

12. Derive the BET adsorption isotherm. Show that it approximates to Langmuir adsorption isotherm under limitng condition.

13. For gaseous carbon monoxide, $^{12}C\,^{16}O$, the IR absorption spectrum consists of a single peak that occurs at a wavenumber of 2143 cm^{-1}. The energy of vibrational energy levels is given by

$$E_{vib} = \left(\nu + \frac{1}{2}\right)\hbar\omega,\ \nu = 0,1,2,.....$$

(a) Calculate the energy difference, in Joule, of successive vibrational energy levels of CO(g), assuming it vibrates as a simple harmonic oscillator. **[7]**

(b) Calculate the force constant of the C-O bond in carbon monoxide **[7]**

(c) Sketch the form of a Morse potential energy curve for the vibrational energy of a diatomic molecule. In your sketch, include the vibrational energy level, illustrating their relative spacing. **[7]**

Paper - III

SECTION-A

Attempt any FIVE questions including Q.1 which is compulsory

1. Answer ALL of the following:

(a) (i) calculate the pH of 1×10^{-8} M H_2SO_4 solution. **[2]**

(ii) Explain the behaviour of NH_4Cl in liquid ammonia solution. **[2]**

(b) Explain why ZnS precipitates on CuS from an acidic solution containing both copper and zinc on passing H_2S? **[4]**

(c) SO_2 and NO_2 in atmosphere are to be analyzed. How do you collect the sample for analysis? **[4]**

(d) Iodometry and iodimetry are two different volumetric methods. Explain the difference between them with suitable examples and how they are useful? **[4]**

(e) A mixture of hydrocarbons are analyzed using Gas chromatography with flame ionization detector. The peaks are sharp.

R_T values and the corresponding intensities are as follows:

S.No.	Name of the compound	R_T value in mins	Signal Intensity
(i)	A	20.7	25
(ii)	B	2.9	500
(iii)	C	14.5	100
(iv)	D	8.0	300
(v)	E	16.3	50
(vi)	F	12.2	150

Draw the corresponding chromatogram. **[4]**

(f) Explain why absorption bands are broad in UV-visible spectra of a coloured organic compound **[4]**

(g) Discuss the difference between Emission and absorption spectra taking Flame photometer and atomic absorption spectrometer **[4]**

(h) X-ray fluorescence (XRF) is used in the analysis of ores and minerals. What parameters in XRF are used? What are the interferences in the analytical method? What steps one should take to overcome them? **[4]**

(i) What is the difference between thermal coal, coking coal and metallurgical coke? What is their composition? How is calorific value of a coal sample determined? **[4]**

(j) What are different types of interferences in the quantitative analysis using ICP-MS? What methods one should use to overcome them? Explain with suitable examples. **[4]**

2. (a) The solubility product constant of CaF_2 in water at 25ºC is $K_{sp} = 4\times10^{-12}$. Calculate the solubility of Ca^{2+} at equilibrium condition and in 0.01 M NaF solution. **[5]**

(b) What are the different sampling methods available for collecting an iron ore gross sample from 100 rakes train? What are the different techniques used to bring the gross iron ore sample collected to laboratory sample? **[5]**

(c) What are the criteria in the selection of a substance as acid-base indicator? How do you select indicators for strong acid-strong base titrations and strong acid-weak base titrations? What is the difference between equivalence point end point in a volumetric titration? **[5]**

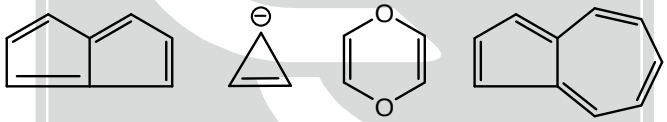
3. (a) Explain the principles of Gas chromatography, high performance liquid chromatography and ion exchange chromatography. What type of substances can be analyzed using the above? **[5]**
   (b) Explain how TLC is superior over Column chromatography **[5]**
   (c) In a water sample pH and F^- are to be determined. What instrument do you use for the analysis of both the parameters? What precautions one should take in the analysis? **[5]**
4. (a) What are the different modes of Atomic Absorption Spectroscopy? What is difference among them? Explain the function of Hollow cathode lamps. **[5]**
   (b) How can you perform the analysis of an XRD of a mineral given to you? Explain the same with Bauxite ore sample. **[5]**
   (c) A sample of water is given for analysis of trace metals in ppb concentration. Which method do you choose and what precaution do you take while performing the analysis? **[5]**
5. (a) What are the different parameters in Proximate analysis of coal? Describe the methods briefly. **[5]**
   (b) List of ores of aluminium and their composition. How do you determine 'Al' in Bauxite? **[5]**
   (c) How do you determine 'Pb' in samples of Petrol and Diesel? **[5]**
6. (a) How do you prepare 100 ppm of sodium chloride and sodium cation in 250 ml volumetric flask separately? **[5]**
   (b) Calculate the concentration of an indicator which has an absorption of 0.85 at 460 nm. The spectrum is taken in 0.5 cm thickness quartz cell. The molar extinction co-efficient of the indicator at 460 nm is $5\times10^{5\ 1}.mole^{-1}.cm^{-1}$. **[5]**
   (c) If 30 ml of 0.1 N $FeSO_4$ was diluted to 100 ml and titrated with 0.1N ceric sulphate with calomel as reference electrode. What was the 'emf' of the cell when 20 ml of $Ce(SO_4)_2$ soluion was added? **[5]**

$$\left(\text{Given}: E^0_{Fe} = +0.771,\ E^0_{SCE} = +0.286\right)$$

SECTION-B

Attempt any FIVE question: (Q.7 which is compulsory).

7. Answer ALL of the following: **4×10=40**
   (a) Write the structure of the compound with molecular formula C_9H_{18} which has only primary hydrogenes. **[4]**
   (b) What do you understand by anti-aromaticity? Which of the following compounds is aromatic and why?



[4]

   (c) How will you make sure whether the two signals separated by 10 hz in the ^1H NMR spectrum are two singlets or a doublet? **[4]**
   (d) Give the basis for distinction between cis-2-butene and trans-2-butene using UV-visible spectroscopy. **[4]**
   (e) How will you determine the molecular weight of a compound which does not show molecular ion in its mass spectrum? **[4]**
   (g) Explain the relative rate of solvolysis of the following tertiiary chlorides:

Compound	**Relative Rate**
Me_3CCl	33
Me_2EtCl	55
Et_3CCl	99
$Me(i\text{-}Pr)_2CCl$	450

[4]

   (h) Write the stereochemical structure of the major product of the following reaction sequence:

$$R-CH_2-SiMe_2 \xrightarrow{EtMgBr} R-\bar{C}H-SiMe_3 \xrightarrow[(ii)\ HF]{(i)\ EtCOMe} \text{Product}(?)$$

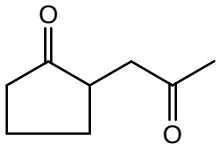
[4]

   (i) Write the main product of reaction between o-dichlorobenzene and sodamide **[4]**
   (j) Explain why anti-Markonikoff addition is not exhibited by HCl or HI when reacted with

$$CH_2=CH-CH_2-CH_3\ ?$$

[4]

8. (a) What is the major product formed when the following compound is treated with a strong base? Give reasons for your answer **[5]**



(b) Explain the concept of thermodynamic and kinetic control of a reaction using the example of the reaction of an unsymmetrical ketone with a base **[5]**

(c) How will you convert cyclohexanone to nylon (6)? Give mechanism of the reactions involved. **[5]**

9. (a) Suggest any two methods for the syntheses of polyvinyl alcohol giving reasons for the better of the two. **[5]**

(b) Explain why 2 + 2 cycloadditions are thermally not favoured while photochemically they are preferred? **[5]**

(c) Claisen rearrangement is belived to involve a concerted pericyclic [3, 3] sigmatropic rearrangement. Explain this reaction by taking phenyl-α-methylallylic ether as an example. **[5]**

10. (a) Draw the stereostructure of the most stable isomer of benzenexachloride and explain why it persists in the soil for a long period? **[5]**

(b) How will you convert cyclohexanone to cyclopentanone in good yield? Give mechanism for the reaction chosen by you. **[5]**

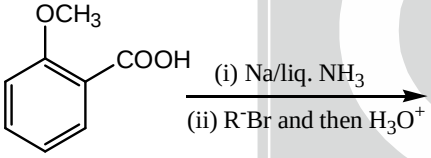
(c) Illustrate the use of boron hydrides for the transformation of isopropanol to n-propanol. **[5]**

11. (a) Explain why 1, 8-(N,N-dimethylamino)-naphthalene is a much stronger base than N, N-dimethylaminobenzene? **[5]**

(b) Give the stereochemical outcome of the following reaction :

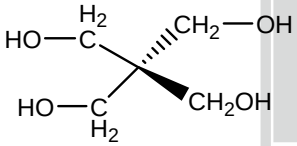
$$Ph - C \equiv CH \xrightarrow[(ii)MeI \text{ in THF at } (-)\,20^{\circ}C]{RMgBr+CuBr} \text{Product}(?)$$ **[5]**

(c) Explain the structure of the product formed in the following reactions:



[5]

12. (a) How will you snthesise A from carbonyl compounds containing one or two carbon atoms **[5]**



(b) The mass spectrum of methyl salicylate shows a strong peak at m/z 120. Explain its origin. **[5]**

(c) A compound having molecular formula $C_8H_8O_2$ showed IR absorption at 1680 cm^{-1} as a strong sharp peak and prominent signals in its ^1H NMR at $\delta\ 3.9(s, 3H), 7.0(d, 2H, J = 8.1\,Hz), 7.8(d, 2H, J = 8.1\,Hz), 9.3(s, 1H)$. Identify the compound. **[5]**