FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2021
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

CHEMISTRY, PAPER-I

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II**. **ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the question will not be considered.
(vii) **Use of calculator is allowed.**

PART-II

Q. 2. **(a)** Explain applications of Schrodinger wave equation to hydrogen and hydrogen like Atom. (10)

(b) **(i)** Give Molecular interpretation of entropy. (05)
(ii) Explain factors affecting the rate of a chemical reactions. (05) (10) **(20)**

Q. 3. **(a)** What are the uses of chelates. (07)

(b) State and explain Nomenclature of coordination complexes. (07)

(c) Explain VBT (Valence Bond Theory) of coordination complexes in detail. (06) **(20)**

Q. 4. **(a)** Explain photoelectric effect and probability density. (10)

(b) **(i)** Explain Eigen function & Eigen value. (05)
(ii) Derive Schrödinger wave equation for a particle in one dimensional box. (05) (10) **(20)**

Q. 5. **(a)** Predict molecular shapes using Valence Shell Electron Pair Repulsion (VESPER) model. (10)

(b) **(i)** Explain the experimental techniques for determination of order of reaction. (05)
(ii) Write a note on thermochemistry and calorimetry. (05) (10) **(20)**

Q. 6. **(a)** Derive a relation for dependence of Gibbs free energy on temperature or Gibbs Helmholtz equation. (07)

(b) What is isothermal process? Explain work done in isothermal reversible expansion of an ideal gas. (07)

(c) Explain fugacity and activity. (06) **(20)**

Q. 7. **(a)** Discuss common ion effect and its industrial applications in detail. (08)

(b) Describe significance of pk_a, pk_b, pH. (06)

(c) Write a note on basic concepts of chemical equilibrium. (06) **(20)**

Q. 8. Write notes on the following:-

(i) Debye-Huckel theory. (07)

(ii) Nernst's equation. (07)

(iii) Electrochemical series. (06) **(20)**

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Roll Number

CHEMISTRY, PAPER-II

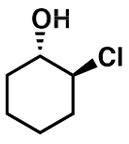
TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

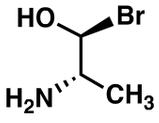
NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II**. **ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the attempted question will not be considered.

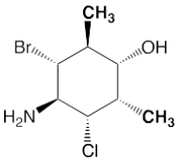
PART-II

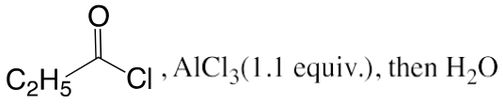
Q. 2. (a) Describe factors that influence keto-enol tautomerization. Elaborate the statement with the help of examples. **(10)**

(b) Assign "R" or "S" configuration on each of the chiral centers of the given compounds**.** **(10) (20)**







Q. 3. (a) Give the products expected (if any) when ethylbenzene reacts under following conditions:
(i) Br_2 in CCl_4 (dark) **(02 marks each)** **(10)**
(ii) HNO_3,H_2SO_4
(iii) Conc. H_2SO_4
(iv) 

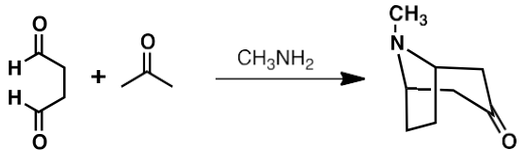
(v) Alkaline $KMnO_4$

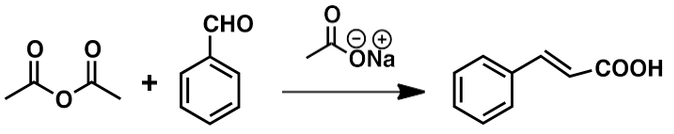
(b) Account for the following: **(05 marks each)** **(10) (20)**
(i) Intramolecular H-bonding is stronger than intermolecular H-bonding
(ii) Control of nucleophilic substitution reaction over elimination reactions

Q. 4. (a) Write down reagents, reaction conditions and important steps for the following conversions: **(10)**
(i) Chlorobenzene to 2,4-dinitrophenyl hydrazine
(ii) Pyridine to 2-amino pyridine

(b) Write a note that substituents on aromatic rings dictate reactivity and orientation of the incoming electrophile in electrophilic aromatic substitution reactions. **(10) (20)**

Q. 5. Draw detailed mechanisms for: **(04 marks each)** **(20)**

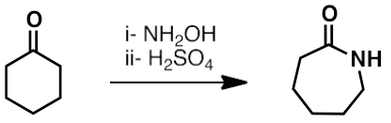
(i) 

(ii) 

(iii) 

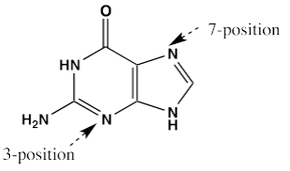
CHEMISTRY, PAPER-II

(iv) 

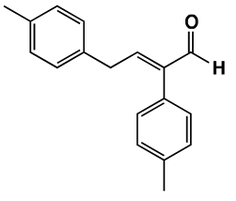
(v) 

Q. 6. Account for the following: **(05 marks each)** **(20)**

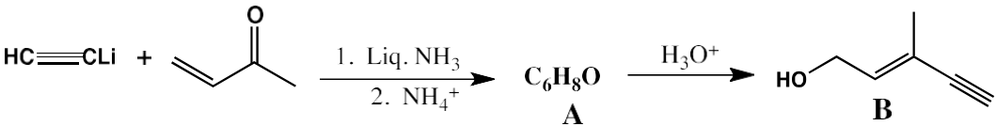
(i) In DNA, a guanine residue reacts with electrophiles predominantly at the 7 and 3 positions of the ring system (see below). Suggest an explanation for this.



(ii) Outline the synthesis of following compound:

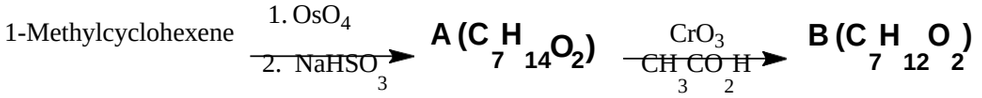


(iii) A Grignard reagent that is a key intermediate in an industrial synthesis of vitamin A can be synthesized in the following way:



What are the structures of compounds A and C? The acid catalysed rearrangement of A to B takes p1.

(iv) What are compounds **A** and **B** in the reaction given below? Compound **B** has a strong IR absorption band in the 1650–1730 cm^{-1} region and a broad strong band in the 3200–3550 cm^{-1} region.



Q. 7. Explain the following: **(04 marks each)** **(20)**

(i) How can IR be used to help interpret NMR spectra?

(ii) What are diastereotopic protons? Explain with examples.

(iii) Determine the structure for a compound with formula $C_6H_4N_2O_4$ with following ^{1}H-NMR data:

δ 8.76 t (1H), 8.38 dd (2H), 7.97 t (1H)

(iv) Assign chemical shifts of each proton in the above structure.

(v) Why ^{13}C-NMR is less sensitive than ^{1}H-NMR?

Q. 8. Answer following questions: **(04 marks each)** **(20)**

(i) Comment if glycogenesis is anabolic or catabolic. Write down all steps involve in glycogenesis.

(ii) Describe endergonic and exergonic reactions

(iii) Write a note on anionic and cationic surfactants.

(iv) Comment if waste glass can be used for cement production.

(v) What is the chemical composition of nucleic acids and their biological significance?

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