

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FIRST SEMESTER EXAMINATION, DECEMBER 2019

FIRST YEAR [BATCH 2019-22]

INDUSTRIAL CHEMISTRY (Honours)

Date : 11/12/2019

Time : 11.00 am – 1.00 pm

Paper : CC1

Full Marks : 50

(Use a separate Answer Book for each group)

Group – A

Answer **any five** questions from Question Nos. **1 to 8** :

[5 × 5]

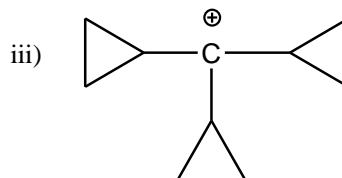
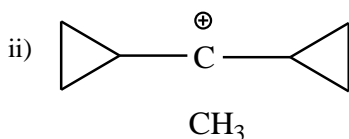
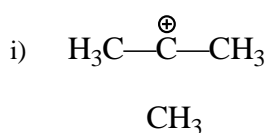
1. a) The observed dipole moment of Nitromethane is higher than the dipole moment calculated from its structural description. Explain.

b) Draw the orbital picture of acetylene ($HC \equiv C - H$) and account the δ and π bond number.

[3+2]

2. a) Arrange the following carbocation according to the decreasing order the stability and justify your answer.

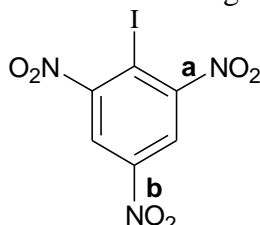
[3]



b) Gauche conformation of ethylene glycol is more stable than the anti-conformation. Offer an explanation.

[2]

3. a) The indicated bonds of picryl iodide differs in length – Explain.



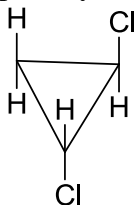
b) Calculate enantiomeric excess from the given data: $[\alpha]_D^{20} = 20^\circ$, optical rotation = 18° .

[3+2]

4. a) Draw the energy profile diagram of different conformers of butane via $C_2 - C_3$ bond rotation.

b) Predict if the following molecule is optically active or not, indicating the symmetry elements.

[3+2]

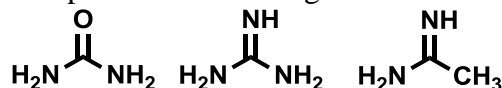


5. a) Arrange the following compounds in increasing order of acid strength and explain; 4-nitrophenol, 2,6-dimethyl-4-nitrophenol and 3,5-dimethyl-4-nitrophenol.

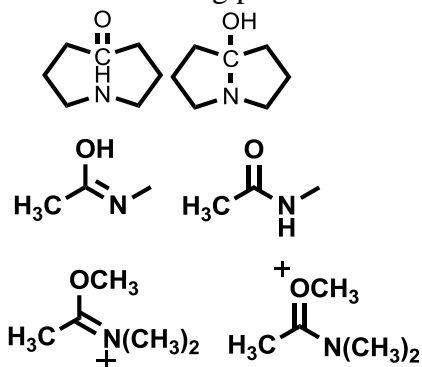
b) Ethyl acetoacetate has 80 % enol contents – Explain.

[3+2]

6. a) Compare the base strength of



b) Are the following pair's tautomer's or resonance canonicals or neither?

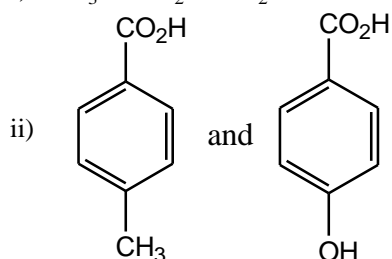


[3+2]

7. a) Compare the acidity of the following pair of acids :

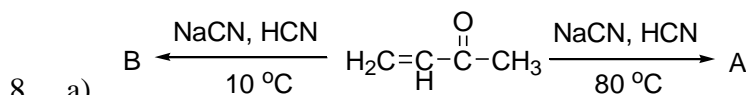
[3]

i) $\text{CH}_3 - \text{CH}_2 - \text{CO}_2\text{H}$ and $\text{Cl} - \text{CH}_2 - \text{CO}_2\text{H}$



b) Phenol is more acidic than cyclohexanol – Explain.

[2]



- Identity A and B with proper structure.
 - Indicate thermodynamic and kinetic Controlled product
 - Draw the energy profile diagram.
 - Which step is reversible and which step is irreversible.
- b) What is proton sponge? Give one example.

[4+1]

Group – B

Answer **any five** questions from Question Nos. **9 to 16** :

[5 × 5]

- Calculate the Ionization Energy of O^{7+} . [2]
 - Calculate the radius of the first allowed Bohr orbit for Hydrogen atom. [1.5]
 - Find out ground state term symbols for Co^{+2} ion. [1.5]
- What is radial distribution function? Show diagrammatically the variation of radial distribution function with 'r' for the orbitals 3s and 3p in a hydrogen atom. [3]
 - Explain why the third Ionisation energy of Magnesium (7750 KJ mol^{-1}) is so much greater than the third ionisation of aluminium (2760 KJ mol^{-1}). [2]
- The 1st IP values of He and Li are 24.5 ev and 5.4 ev respectively. Calculate the Z^* value and screening constant for the outer most electron in the He and Li. [3]
 - State Hund's rule of maximum multiplicity. Calculate the exchange energy for d^6 system. [2]
- Chose the best response among the following options for each question. [1×5]
 - AB is predominately ionic as A^+B^- if
 - $(\text{IP})_{\text{A}} < (\text{IP})_{\text{B}}$
 - $(\text{IP})_{\text{B}} < (\text{IP})_{\text{A}}$

- iii) $(EN)_A < (EN)_B$
 iv) $(EA)_A < (EA)_B$
- b) Which of the following species has tetrahedral geometry?
 i) BH_4^-
 ii) NH_2^-
 iii) CO_3^{2-}
 iv) H_3O^+
- c) Correct Melting Point order
 i) $NaCl < NaI < NaF < NaBr$
 ii) $NaBr < NaF < NaCl < NaI$
 iii) $NaI < NaBr < NaCl < NaF$
 iv) $NaF < NaCl < NaBr < NaI$
- d) CO is isoelectric with
 i) NO^+
 ii) N_2
 iii) $SnCl_2$
 iv) NO_2^-
- e) Among the following the maximum covalent character is shown by the compound
 i) $MgCl_2$
 ii) $FeCl_2$
 iii) $SnCl_2$
 iv) $AlCl_3$
13. a) Explain why PCl_5 is trigonal bi-pyramid whereas IF_5 is square pyramid.
 b) Determine lattice energy of $LiF_{(s)}$ according to given data.
 i) $Li_{(s)} \rightarrow Li_{(g)} \quad 155.2 \text{ KJ mol}^{-1} (\Delta H_s)$
 ii) $F_{2(g)} \rightarrow 2F_{(g)} \quad 75.2 \text{ KJ} \left(\frac{\Delta H_D}{2} \right)$
 iii) $Li_{(g)} \rightarrow Li_{(g)} + e \quad 520.0 \text{ KJ mol}^{-1} (\Delta H_i)$
 iv) $F_{(g)} + e^- \rightarrow F_{(g)}^- \quad -33.0 \text{ KJ} (\Delta H_{EA})$
 v) $Li_{(s)} + \frac{1}{2} F_{(g)} \rightarrow LiF_{(s)} \quad -504.1 \text{ KJ mol} (\Delta H_f)$ [2+3]
14. a) Prove that – "radius ratio in case of Tetrahedral geometry is close to 0.225".
 b) Assuming Rock salt structure for $RbBr$, calculate the lattice energy using Born-Lande equation. Given,
 R of $Rb^+ = 265 \text{ pm}$
 R of $Br^- = 94 \text{ pm}$
 A = 1.75 [2+3]
15. a) Match the columns
- | | Column I (atomic no) | Column II (position) |
|---|----------------------|----------------------|
| A | 52 | s-block |
| B | 56 | p-block |
| C | 57 | d-block |
| D | 60 | f-block |
- b) Why is $SnCl_2$ a solid and $SnCl_4$ is liquid?

c) What is scandide contradiction?

[2+2+1]

16. a) The electron configuration of elements of A,B and C are $[He]2s^1$, $[Ne]3s^1$ and $[Ar]4s^1$ respectively. What is correct order for the first ionization potentials (in $KJ\ mol^{-1}$) of A, B and C and explain?

b) When elements with atomic number 118 is discovered, what family will it be in?

c) What is the difference between electronegativity and electron affinity? How does it increase and decrease in groups and periods?

[2+1+2]

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