3 Yr. Degree/4 Yr. Honours 2nd Semester Examination, 2025 (CCFUP)

Subject : Chemistry

Course: CHEM2011

(Basic Chemistry-II)

Time: 2 Hours **Full Marks: 40**

The figures in the right hand margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

1. Answer *any five* questions: 2×5=10

(a) What are ambident nucleophiles? Give one example of such nucleophile showing its nucleophilic centres.

(b) Identify X and Y, where $(\delta P/\delta T)_V = (\delta S/\delta X)_Y$.

(c) KHF_2 is a stable compound, but $KHBr_2$ does not exist. —Why?

(d) Write down the conditions of spontaneity in terms of ΔG and ΔS.

(e) What is oxidation number? Give an example of a compound where the constituent element exhibits fractional oxidation number.

(f) With suitable examples show two tautomerisms other than keto-enol system.

(g) The van der Waals constants for CO_2 are estimated to be 3.59 L^2 atm mol^{-2} and 43 cc mol^{-1}. What is the inversion temperature of the gas?

(h) Draw the Fischer Projection of (2*R*,3*S*)-3-chloro-2-pentanol.

2. Answer *any two* questions: 5×2=10

(a) (i) When a solution of optically active s-butyl phenyl ketone in aqueous ethanol is treated with acid and base, the solution looses its optical activity. —Explain.

(ii) What do you mean by "optical purity of an enantiomeric mixture is 63% with respect to 1-isomer"? 3+2

(b) (i) Which one between H_2O and H_2S molecules has a greater bond angle and why?

(ii) Between NH_3 and NF_3, which one is more polar and why?

(iii) Give an example of a disproportionation reaction. 2+2+1

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(c) (i) A spherical drop of H_2O of 0.4 cm in radius is split up into 125 tiny droplets. Find the increase in the surface energy (ν_{H_2O} = 72 dynes cm^{-1}).

(ii) Explain the variation of viscosity of liquid with temperature.

(d) (i) Show that surface tension and surface energy have same dimension. 3+2

(ii) The melting point of CaI_2 (575°C) is much lower than that of CaF_2 (1392°C). —Explain.

(iii) How can you differentiate an asymmetric molecule from dissymmetric molecule? 2+2+1

3. Answer *any two* questions: 10×2=20

(a) (i) If the speed distribution function is given by $\frac{dn_c}{n} = Ac^m e^{-bc^2} dc$, find dimensions of A and B. Find also the relation between A and B from normalization condition (for $m = 2$).

(ii) Calculate entropy change for the following process:

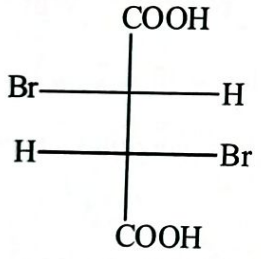
One mole H_2O (l, −10°C, 1 atm) → One mole H_2O (s, −10°C, 1 atm)

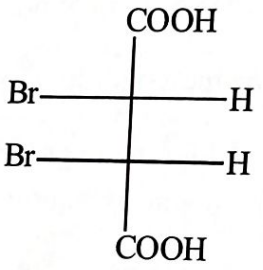
Given, C_p (H_2O, l) = 75.42 $J.K^{-1}$ and C_p (H_2O, s) = 37.20 $J.K^{-1}$

(iii) How does Carnot's cycle look like in T-S diagram? (2+2)+4+2

(b) (i) Assign the following pairs as enantiomers, diastereomers and homomers.

(I)





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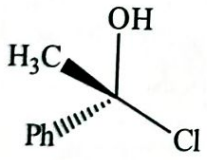

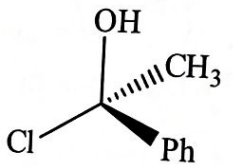

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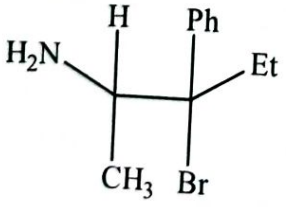

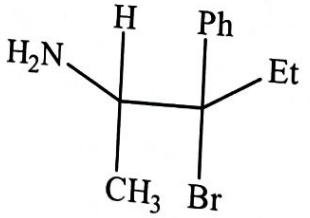

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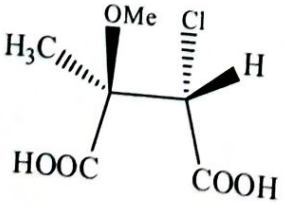
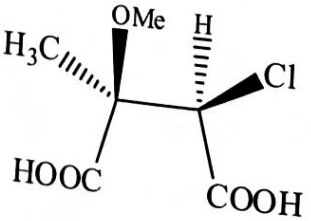




(ii) Triethylmethylchloride undergoes nucleophilic substitution reaction 10^6 times faster than 1-chlorobicyclo-[2,2,2] octane. —Justify.

(iii) What is primary kinetic isotope effect? Explain with an example.

(iv) Which tautomer is favored in 1,3-dicarbonyl compounds? 4+3+2+1

(c) (i) Balance the following chemical reaction by ion electron method:

$K_2Cr_2O_7 + H_2SO_4 + H_2S \rightarrow Cr_2(SO_4)_3 + S + K_2SO_4 + H_2O$

(ii) Which one should have higher bond angle and why?

F_2O and Cl_2O

(iii) The dissociation of H_2S decreases in presence of dil. HCl. —Explain.

(iv) Copper displaces zinc from a solution of zinc salt containing excess KCN. —Explain. 2+3+2+3

(d) (i) Apply VSEPR theory to predict and draw structure of the following.

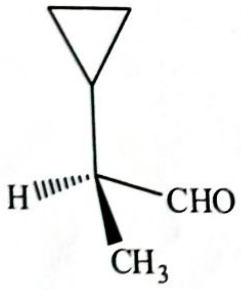
ClF_3 and XeF_4

(ii) The molecules of a gas are confined to move in a place. Derive the expression for rms speed of the gas.

(iii) Draw all possible stereoisomers of Ph CH(OH)CH = CHMe.

(iv) Assign *R/S* designation of the following compounds: 3+2+2+3

(I)



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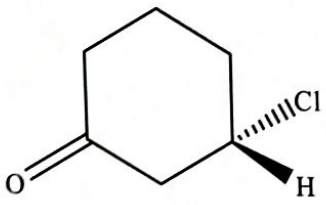

(III)