2022

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer ***all*** questions

Part-I

1. Fill in the blanks : 1×8

   a) _____ is the first organic compound which was synthesized in the laboratory.

   b) The Hybridisation of a carbanion is ____ .

   c) The absolute cofiguration of D(+)-Glyceraldehyde is _____ .

   d) A racemic mixture is optically _____.

   e) Out of boat and twist boat, _____ is the most stable conformation of cyclohexane.

   f) Elimination reaction generally occurs with the formation of _____ .

g) The number of delocalised π electrons in pyrrole is _____.

h) _____ is the reactive species in sulphonation of benzene.

Part-II

2. Answer any ***eight*** of the following : 1½ × 8

a) Define resonance energy.

b) How inductive effect responsible for strength of an acid ?

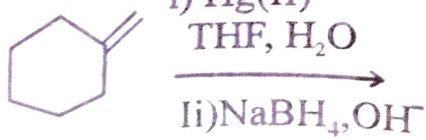
c) What do you mean by 'relative configuration' ?

d) Distinguish between enatiomers and diasteromers.

e) Draw the structure of (2R)-2-bromobutane.

f) What is nucleophilic elimination reaction ?

g) Write product(s) for the reaction below :



h) What is hydroxylation reaction ?

i) What is Huckel's rule for aromaticity of a compound ?

j) What do you understand by directing effect of a functional group attached to an aromatic ring ?

Part-III

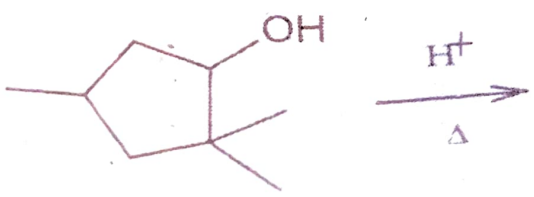
3. Answer any *eight* of the following : 2×8

a) Explain the acidity characteristics of phenol based on resonance effect.

b) Draw the Newman projection for eclipsed form of 2-methyl propane.

c) Draw the structure of the (2S, 3E)-2-hydroxypent-3-enal.

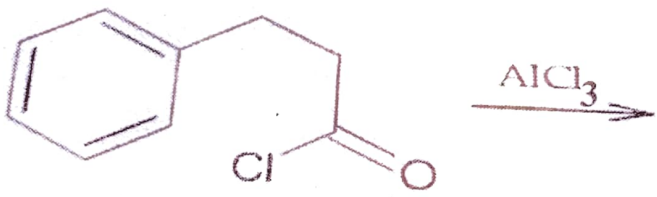
d) Find product (s) for the reaction below :



e) Briefly discuss radical substitution of halogen by hydrogen with a suitable example ?

f) Why pyrrole behaves as a much weaker base than pyridine, though both are aromatic compounds.

g) Find major product for the following reaction :



h) With example, draw base catalysed hydration of a carbonyl compound.

i) Draw energy profile diagram for an E_1cB mechanism.

j) Write down the product for the following reaction :

$$H_3CC \equiv CCH_3 \xrightarrow[2.H_2O]{1.O_3}$$

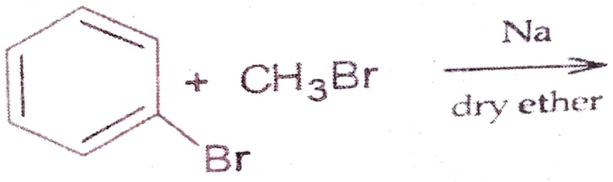
Part-IV

4. a) What is a carbocation ? Taking suitable examples briefly explain the generation, structure and stability of the carbocation. 6

OR

b) Predict the products and mechanism for the reactions below : 6

i) $H_2C{=}CHR + Cl_3CBr \xrightarrow[\Delta]{\text{Peroxide}}$

ii) 

5. a) What do you mean by absolute and relative configuration ? Explain each with examples. 6

OR

b) Explain term in brief relating to stereochemistry of molecules.

i) Specific rotation

ii) Chiral centres

iii) Racemic mixture. 6

6. a) While treating with HCl, propenoic acid gives the Anti-Markownikoff product, whereas 4-pentenoic acid gives the Markownikoff product. Explain why ? 3

b) Why (2Z, 4Z) -2, 4-hexadiene is less reactive than (2E, 4E) -2, 4-hexadiene in a Diels-Alder reaction ? 3

OR

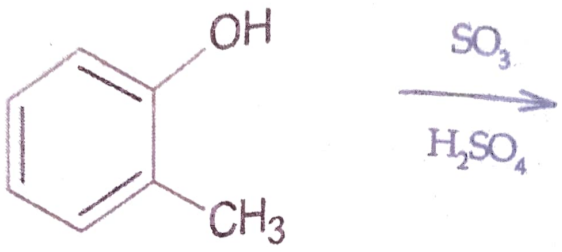
c) Why vinyl halide and aryl halides don't react in Friedel-Craft's reaction ? 3

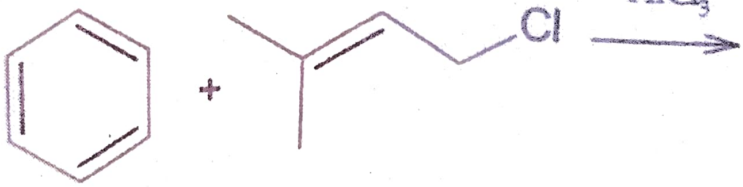
d) What is syn-elimination ? When such eliminations are favoured over trans-elimination ? 3

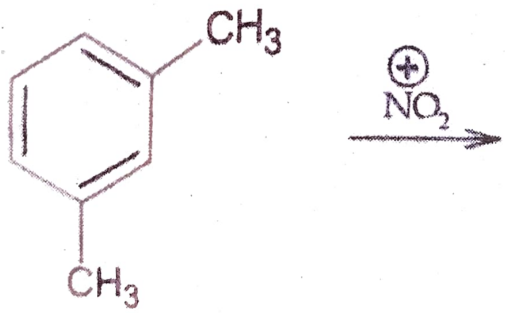
7. a) What is electrophilic aromatic substitution ? Why aromatic substrate with meta-directing group dosen't exhibit Friedel-Craft's reaction. 6

OR

b) Write down products for the following reaction : 6

i) 

ii) 

iii) 

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Answer *all* questions

Part-I

1. Answer the following : 1×8

   a) Represent first law of Termodynamics, when work done on the system.

   b) Which of the following is/are intensive property Viscosity, volume, energy.

   c) The entropy is regarded as a measure of the____ of a system.

   d) Write entropy condition for reversible process.

   e) The partial molar free energy is known as ____.

   f) Write the unit of Kp.

   g) Give an example of binary solution.

   h) Colligative properties does not depends on ____of the solute.

Part-II

2. Answer any ***eight*** of the following : $1\frac{1}{2} \times 8$

   a) Represent the relation between enthalpy, internal energy and pressure.

b) Define open system with an example.

c) Represent second law of Thermodynamics, mathematically.

d) Write the conditions for spontaneity of a reaction.

e) Write Gibb's Helmholtz equation for an isochoric process.

f) Give an idea on partial molar entropy.

g) Write the fugacity expression at very low pressure.

h) Write Henry's law.

i) Write the Van,t Hoff equation for osmotic pressure of a dilute solution.

j) Entropy of a solution of solid in water is $-41.6 KJmol^{-1}$. When NaOH is dissolved in water, the temperature of the water will be ?

Part-III

3. Answer any ***eight*** of the following : 2×8

a) Differentiate bond energy and bond dissociation energy.

b) Calculate q, for the isothermal expression of one mole of an ideal gas at 27^0C from a volume of $10dm^3$ to a volume of $20\ dm^3$ against a constant external pressure of 1 atm.

c) Give an idea on residual entropy.

d) Derive Maxwell's thermodynamic relation $(\partial T/\partial V)s = -(\partial P/\partial S)v$

e) Give an idea on work function.

f) Write the variation of partial molar free energy with temperature.

g) Write the integrated Van,t Hoff equation.

h) Write the significance of the Kp and Kc.

i) Define Osmosis and osmotic pressure.

j) 1.20 g of a non-volatile organic substance was dissolved in 100g of acetone at 20^0C. The vapour pressure of the solution was found to be 182.5 torr. Calculate the molar mass of the substance.(Vapour pressure of acetone at 20^0C is 185.0 torr.)

Part-IV

4. a) Define the term internal energy change and enthalpy change of a system. Derive the relation between them for an ideal gas. 6

OR

b) What is bond energy ? Explain how do you calculate enthalpy of reaction from bond energy.

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Answer ***all*** questions

Part-I

1. Answer the following : 1×8

   a) If a gas at constant temperature and Pressure expands then its internal energy ____.

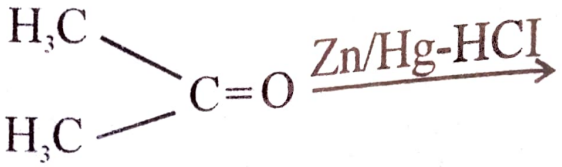
   b) The enthalpies of the element in their standard states are assume to be ____ at 298 K.

   c) Write the units of Kc.

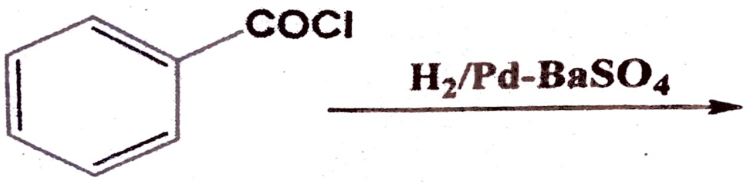
   d) Write Henderson-Hasselbalch equation.

   e) Why Aryl halide cannot be prepare by direct Fluorination ?

f) Predict the major product of the following reaction.



g) Write the desire product of the following reaction.



h) Write the two uses of Phenol.

Part-II

2. Answer any ***eight*** of the following : $1\frac{1}{2} \times 8$

a) Write the relation between Enthalpy of reaction at constant volume and at costant pressure.

b) Which of the following is/are macroscopic properties.

Volume, Internal energy, Enthalpy.

c) Give one example of each strong and moderate electrolytes.

d) Calculate the pH and pOH of 0.03M solution of HCl at 25^0C.

e) Write the relation between Kp and Kc for general reaction

$aA + bB \rightleftarrows cC + dD$

f) Why chlorobenzene is less reactive than benzyl chloride ?

g) Why aromatic amines do not undergo Friedel Craft reactions ?

h) What is the product obtained when ethyl alcohol react with phosphorous halide ?

i) Write the preparation of secondary alchohol from ketone.

j) Write the reagent name (A) and product (B) of the reaction.

$$CH_3CHO \xrightarrow{[A]} CH_3CH{=}NNH_2 \xrightarrow{KOH} [B]$$

Part-III

3. Answer any ***eight*** of the following : 2×8

a) What is the effect of pressure on equilibrium by doubling the volume on the following system at 500^0C ?

$$H_2(g) + I_2 \rightleftarrows 2HI(g)$$

b) Write the significance of Kp and Kc.

c) Write the relation between solubility product and molar solubility of a sparingly soluble salt.

d) In 0.1m solution, 0.00135 mole ammonia dissociates. Calculate the dissociation constant of the base.

e) Calculate the solubility product of $BaSO_4$ having solubility 1.05×10^{-5} $mol.dm^{-3}$.

f) Write the basic difference between SN^1 and SN^2 reaction.

g) Give the mechanism of sulphonation of benzene.

h) How does ethyl iodide react with (i) Na and (ii) aqueous KOH.

i) How is diethyl ether prepared in the laboratory ?

j) Write the method of preparation of vicinal diol.

Part-IV

4. a) State and explain 3rd law of themodynamics. 6

OR

b) State the law of chemical equilibrium. How it can be derive on thermodynamic consideration ?

5. a) Discuss in detail the phenomenon of hydrolysis of salts. Illustrate your answer taking example of a weak acid and strong base. 6

OR

b) What is acid base indicators ? Illustrate the mechanism of their action taking suitable example.

6. a) Explain why benzene undergoes electrophilic substitution reaction whereas alkenes undergo addition reactions. 6

OR

b) How aryl halides prepare from diazonium salt ? Give in details the nucleophilic and electrophilic sustitution raction in aryl halides.

7. a) Write short notes on the following. 6

i) Benzoin Condensation

ii) Pinacole-Pinacolone rearrangements.

OR

b) Describe the general methods of preparation of Acetaldehyde. What happens when Acetaldehyde react with (i) HCN and (ii) saturated solution of $NaHSO_3$? 6

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