3 (Sem–3/CBCS) CHE HC 1

2024

CHEMISTRY

(Honours Core)

Paper : CHE–HC–3016

(Inorganic Chemistry–II)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following as directed : 1×7=7

   (a) The process used to remove silver and copper from impure gold is called—

   (i) Van Arkel process

   (ii) Kroll process

   (iii) Parting process

   (iv) Vapour phase method

   (Choose the correct option)

   (b) Arrange the following compounds in the decreasing order of their relative acidic strength.

   BF_3, BBr_3, BCl_3

   (c) Explain why does $BiCl_5$ not exist.

   (d) Explain why is Borax used in softening of water.

(e) "Raman spectra of diborane gives two intense frequencies."—State whether the statement is true ***or*** false.

(f) The shape of XeF_4 molecule is _____. *(Fill in the blank)*

(g) What is the type of hybridisation of Boron in diborane ?

(i) sp^3
(ii) sp^2
(iii) d^2sp^3
(iv) sp^3d^2

2. Answer the following questions : 2×4=8

(a) Li_2CO_3 is thermally unstable. Explain why.

(b) Describe the structure of Cl_2O_7.

(c) Why does urea behave as an acid in liquid ammonia ?

(d) How is *N*-trimethylborazine formed ? Give chemical reactions.

3. Answer ***any three*** of the following : 5×3=15

(a) Briefly discuss the bonding and structure of diborane.

(b) What is Pearson's HSAB principle ? On the basis of HSAB principle explain why $[Co(CN)_5I]^{3-}$ and $[Co(NH_3)_5F]^{2+}$ are stable while $[Co(CN)_5F]^{3-}$ and $[Co(NH_3)_5I]^{2+}$ are unstable complexes. 1+4=5

(c) What are interhalogen compounds ? Explain the structure of ClF_3 molecule. 1+4=5

(d) Discuss how copper can be purified from crude copper.

(e) On the basis of VSEPR theory, explain the structure of XeF_6 molecule.

4. Answer ***any three*** of the following : 10×3=30

(a) (i) What is inorganic benzene ? How can it be prepared in the laboratory ? Describe its structure on the basis of molecular orbital concept. 1+2+5=8

(ii) Why polysulphate is considered the best fertilizers ? 2

(b) (i) Complete the following reactions : 1×4=4

$2XeF_6 + SiO_2 \longrightarrow$?

$XeF_4 + 4KI \longrightarrow$?

$2CH_2 = CH_2 + 2XeF_2 \longrightarrow$?

$B_2H_6 + x\,NH_3\,(excess) \xrightarrow{\text{High tempr.}}$?

(ii) What are silicones ? How many types of silicones are there ? How linear silicones can be prepared ? 1+1+4=6

(c) (i) What are clathrate compounds? Discuss these clathrates with reference to gas hydrates. Why do *He* and *Ne* not form clathrate? 2+3+1=6

(ii) Discuss Van Arkel method of purification of zirconium and titanium. 4

(d) Write notes on : ***(any two)*** 5+5=10

(i) Polyhalides

(ii) Graphite

(iii) Diagonal relationship

(e) (i) Give the formula, structure and method of preparation of basic beryllium nitrate. 1+2+2=5

(ii) Discuss the laboratory method of preparation of P_4O_6. Explain the structure of P_4O_6. 2+3=5

(f) (i) Name and draw the structures of two oxyacids of nitrogen. Which oxyacid of nitrogen acts both as oxidizing agent as well as reducing agent and why? 2+1+1=4

(ii) Why Lithium compounds are soluble in organic solvent? 2

(iii) Write down the main reasons for the anomalous behaviour of fluorine. Mention *two* anomalous behaviour of fluorine. 2+2=4

2024

CHEMISTRY

(Honours Core)

Paper : CHE–HC–3026

(Organic Chemistry II)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : 1×7=7

   (a) How the ionizing power of a solvent is reflected in its dielectric constant ?

   (b) What happens when ether is treated with concentrated *HCl* ?

   (c) What do you mean by active methylene compound ?

   (d) Why formaldehyde cannot give aldol product ?

(e) What happens when glycol is treated with lead tetraacetate in presence of acetic acid ?

(f) Write the name of the organic compound used to detect leakage of the gas cylinder.

(g) Which of the following is used as 'sleeping drug' ?

(i) Sulphonal

(ii) Mustard gas

(iii) Sulphone

(iv) None of the above

2. Answer the following questions : 2×4=8

(a) What happens when thioalcohols react with alkyl halides in presence of base ?

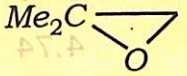
(b) Write the name of the product

(i) $CH_3CHO \xrightarrow{Zn-Hg,\,HCl}$ Product

(ii) $RCHO \xrightarrow{LiAlH_4}$ Product

(c) Write the role of electron withdrawing and donating substituent in the acidity of phenol.

(d) Complete the following reaction :



3. Answer the following questions : ***(any three)***

(a) Write a method of preparation of Grignard reagent ? Why THF is used in Grignard reaction ? Give some synthetic applications of Grignard reagent. 2+1+2=5

(b) Write short notes on : 2.5×2=5

(i) Curtius Rearrangement

(ii) Reformatsky Reaction

(c) Complete the following reactions : 1×5=5

(i) $RCONH_2 \xrightarrow{Br_2,\,KOH}$ Product

(ii) $C_2H_5COOC_2H_5 \xrightarrow[2H_3O^+]{2C_2H_5MgBr}$ Product

(iii) $R-COOR' \xrightarrow{LiAlH_4}$ Product

(iv) $C_6H_5COOH + SOCl_2 \longrightarrow$ Product

(v) $CH_3CH_2COCl + H_2 \xrightarrow[\text{quinoline}]{Pd/BaSO_4}$ Product

(d) (i) The *pKa* values of the following carboxylic acids are as below : 3

CH_3COOH	4.74
$CH_3CH_2CH(Cl)COOH$	2.84
Cl_3CCOOH	0.65
$CH_3CH(Cl)CH_2COOH$	4.06

Explain the variation in such acidic strength of carboxylic acid.

(ii) What happens when aeetaldehyde is treated with diethylmalonate in presence of a base ? 2

(e) Write a chemical equation for each of the following : 5

(i) Cholorobenzene reacts with acetyl chloride in presence of anhydrous $AlCl_3$

(ii) Chloroform is heated with Phenol in presence of *KOH* at 340 *K*

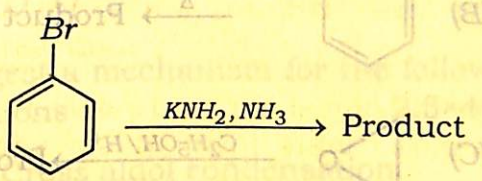
(iii) Conversion of benzyl chloride into benzaldehyde

(iv) Alkyl halide is treated with silver salt of carboxylic acid

(v) tert-Butyl chloride is treated with magnesium and dry ether in presence of water

4. Answer the following questions : ***(any three)***

(a) (i) What is Benzyne ? Complete the following reaction using this mechanism : 1+3=4



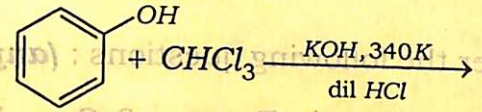
(ii) Discuss the relative reactivity of allyl, benzyl, vinyl and aryl halides towards nucleophilic substitution reactions. 4

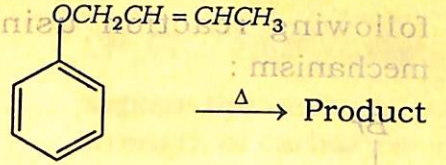
(iii) What do you mean by diazonium salt ? Write a method of preparation of diazonium salt. 2

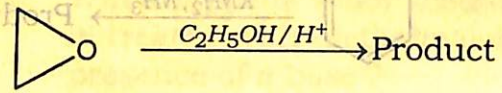
(b) (i) Write a brief note on the steric orientation of SN1 and SN2 reactions ? 4

(ii) Discuss about the factors affecting the reactivity of alkyl halides in substitution reaction. 6

(c) (i) Complete the following reactions and give mechanism : 3+3+2=8

(A) 

(B) 

(C) 

(ii) What do you mean by iodoform test ? How it is used to distinguish alcohols ? 2

(d) Write short notes on : 3.5×2=7

(A) (i) Pinacole-Pinacolone rearrangement

(ii) Kolbe-Schimitt reaction

(B) Describe why phenols are more acidic than alcohols. 3

(e) Complete the following reactions and give mechanism : 3+3+4=10

(i) $C_6H_5CH_2OH + (CH_3CH_2CO)_2O \xrightarrow{EtCOONa}$ Product

(ii) $2CH_3CH_2CHO \xrightarrow{H^+}$ Product

(iii) $Ph-\underset{\underset{O}{\|}}{C}-\underset{\underset{O}{\|}}{C}-Ph + NaOH \longrightarrow$ Product

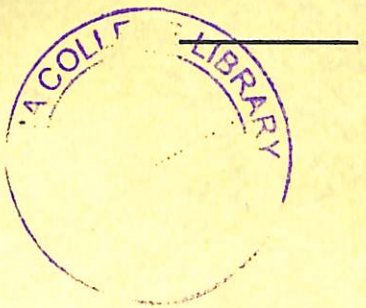
(f) Suggest a mechanism for the following reactions : 2.5×4=10

(i) Cross aldol condensation

(ii) Benzoin Condensation

(iii) Knoevenagel reaction

(iv) Clemmensen reduction



3 (Sem–3 / CBCS) CHE HC 3

2024

CHEMISTRY

(Honours Core)

Paper : CHE–HC–3036

(Physical Chemistry–III)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following as directed : 1×7=7

   (i) What is the number of phases in ice and water system ?

   (ii) What is the unit of k for 1st order reaction ?

(iii) At triple point of water, how many phases coexist?

(iv) Give an example of parallel reaction.

(v) Molecularity of a reaction may be zero. *(State as True or False)*

(vi) A catalyst is unchanged chemically at the end of the reaction. *(State as True or False)*

(vii) Give an example of a *one*-component system.

2. Answer the following questions : 2×4=8

(i) Distinguish between order and molecularity of a reaction.

(ii) What is an azeotropic mixture?

(iii) State and explain the steady state approximation.

(iv) Why are solid catalysts generally used in the finally divided state?

3. Answer ***any three*** of the following questions : 5×3=15

(a) Draw and explain the phase diagram of water system.

(b) (i) Derive an expression of rate constant k for a first order reaction. 3

(ii) Write *two* characteristics of a first order reaction. 2

(c) (i) What is catalysis? 1

(ii) How many types of catalysis are there? Give examples of each type. 2+2=4

(d) Distinguish between physisorption and chemisorption. Give example of each type. Why chemisorption is stronger than physisorption? 2+2+1=5

(e) Write one suitable method of determination of order of reaction. Write *one* example of reaction where both order and molecularity is same. 4+1=5

4. Answer ***any three*** questions from the following : 10×3=30

(a) (i) Define the terms 'phase' and 'components' of a system. How many phases and components are present in the following systems ? 3+2=5

A. Ice, liquid water and water vapours

B. $CaCO_3$, CaO and CO_2

(ii) Write and derive the phase rule. 1+4=5

(b) (i) Derive the rate constant k for 2nd order reaction of type

$2A \rightarrow$ Product 4

(ii) Show that half-life period ($t_{1/2}$) of 2nd order reaction is inversely proportional to the initial concentration of the reactant. 2

(iii) Show that the time taken for 99% of the first order reaction to take place is twice the time required for 90% of the reaction. 4

(c) (i) Derive Clausius–Clapeyron equation for liquid ⇌ vapour system. How will you obtain the heat of vapourisation using this equation ? 4+2=6

(ii) Discuss ideal and non-ideal solutions with examples. 4

(d) Write the assumptions of Langmuir adsorption isotherm. Deduce Langmuir adsorption isotherm by considering these assumptions. Under what condition does Langmuir isotherm will be same as Freundlich adsorption isotherm ? 3+5=2=10

(e) I. Explain the following terms used in phase rule study of heterogeneous equilibrium :

(i) Eutectic point

(ii) Triple point

(iii) Eutectic temperature 3

II. Discuss about two-component system of lead-silver system. 5

III. What is solid solution? Give example. 2

(f) (i) What is activation energy of a reaction? How it can be determined using Arrhenius equation? 2+3=5

(ii) What is an enzyme? Give example. 2

(iii) Write about specificity and selectivity of a catalyst. 3
