IV Semester B.Sc. Examination (CBCS)
CHEMISTRY (Paper-IV)-Model Paper-1
Chemistry-IV
Model Paper-1

Time: 3 Hours Max.Marks: 70

Instructions: *1) The question paper has two parts. Answer both the parts.*
2) Draw diagrams and write chemical equations wherever necessary.

PART-A

Answer **any eight** of the following questions: (8x2=16)

1. State the condensed Phase rule and indicate the terms.
2. What are eutectic mixtures? Give an example.
3. Give the lattice unit cell dimensions for cubic crystal system.
4. Name any two physical and chemical impurities present in water.
5. What is tempering of steel. Mention its effect on the property of steel.
6. Define mass defect.
7. Complete the following nuclear reactions:

i) $^{14}_{7}N + \ldots\ldots \rightarrow {}^{17}_{9}F + {}^{1}_{o}n$ **ii)** $^{9}_{4}Be + {}^{2}_{1}H \rightarrow {}^{10}_{5}B + \ldots\ldots$

8. Explain Perkin Condensation with an example.
9. How is benzaldehyde obtained by Gattermann-Koch synthesis?
10. What is the action of heat on succinic acid, Explain with equation?
11. Write the keto-enol form of ethyl acetoacetate.
12. What is Greenhouse Effect? Mention any two Greenhouse gases.

PART-B

Answer **any nine** of the following questions: 9x6=54)

13. a) Construct the phase diagram of water system and explain its salient features.
b) Mention the number of phases in the following systems: (4+2)

i) $H_{2(g)} + O_{2(g)} \rightarrow H_2O_{(g)}$

ii) $CaCO_{3(s)} \leftrightharpoons CaO_{(s)} + CO_{2(g)}$

14. a) Derive Bragg's equation, $n\lambda = 2d \sin\theta$.
b) Sketch the unit cell of CsCl and indicate Cs^+ and Cl^- in it. (4+2)

15. a) Describe High temperature super conductors with suitable examples.
b) Define number of degrees of freedom of a system. What is value for an invariant system? (3+3)

16. a) Write a note on hardness of water.
b) What is powder metallurgy? Give two advantages. (3+3)

17.a) Derive the relation $N = N_0e^{-\lambda t}$ for the decay of a radioactive element.
b) What is the role of a coolant in a nuclear reactor? Give two examples for a coolant. (3+3)

18. a) Define the following with two examples for each:i) Isotopes ii) Projectiles.
b) State Group displacement law. (4+2)

19. a) Describe the production of tungsten powder from wolframite.
b)How does acetyl chloride react with ammonia? (4+2)

20. a) Describe the manufacture of ferrosilicon.
b) What is Austenite? Mention its properties. (4+2)

21. a) Explain the mechanism of Aldol Condensation.
b) How is acetone obtained from methyl cyanide? (4+2)

22. a) Explain the reactions of: i) Acetaldyhyde with ethanol ii) Acetone with $LiAlH_4$
b) How is acetyl chloride converted to acetaldehyde? (4+2)

23. a) Write notes on: i) Hell-Vollhard-Zelinski reaction? ii) saponification reaction.
b) Arrange the following in the increasing order of acid strength
CH_3COOH, $Cl_2CHCOOH$, $ClCH_2COOH$, Cl_3CCOOH. (4+2)

24. a) How are following compound prepared from ethyl acetoacetate?
i) Butanoic acid and ii)Cinnamic acid
b) Differentiate between tautomerism and resonance? (4+2)

25. a) Describe the different stages of sewage treatment.
b) Define Biochemical Oxygen Demand. (4+2)

IV Semester B.Sc. Examination (CBCS)
CHEMISTRY (Paper-IV)-Model Paper-1
Chemistry-IV
Model Paper-1- Key Answers

Time: 3 Hours Max.Marks: 70

Instructions: 1) The question paper has two parts. Answer both the parts.
2) Draw diagrams and write chemical equations wherever necessary.

PART-A

Answer **any eight** of the following questions: (8x2=16)

1. State the condensed Phase rule and indicate the terms.

Ans: Statement of Condensed Phase Rule: $F = C - P + 1$; Where, F = number of degrees of freedom , C = number of components, P = number of phases at equilibrium

2. What are eutectic mixtures? Give an example.

Ans: Eutectic mixtures: An eutectic mixture is defined as a mixture of two or more components, having a definite composition and possessing lowest melting or freezing point than any of the components Examples (any one of the following):

1. In water-KI system, a eutectic mixture of 58% of KI + 48% H2O exists at the eutectic temperature of -220C
2. In Pb-Ag system, a eutectic mixture of 97.6% Pb + 2.4% Ag exists at the eutectic temperature of 3030C

3. Give the lattice unit cell dimensions for cubic crystal system.

Ans: Lattice unit cell dimensions for cubic crystal system: i) $\alpha = \beta = \gamma = 90^0$, ii) a =b = c.

4. Name any two physical and chemical impurities present in water.

Ans: Two examples each for physical and chemical impurities present in water**:**
Physical impurities: Dirt, fine sand, clay, rust, etc (any two) Chemical impurities: Metals like iron, aluminium and manganese, salts of Arsenic, Barium, Cadmium, lead, mercury, selenium, silver, etc, fluorides, nitrates, nitrites and organic chemi-cals like chloroform, haloacetic acids (HAA), trihalomethanes(THM) (any two)

5. What is tempering of steel. Mention its effect on the property of steel

Ans**:** A process where hardened steel is reheated between 200^0C to 700^0C to remove the internal stresses is called tempering. From this process, resulting steel becomes less hardened and more ductile.

6. Define mass defect.

Ans: Mass defect is the difference between the sum of masses of the nucleons present in the nucleus and the actual mass of the nucleus

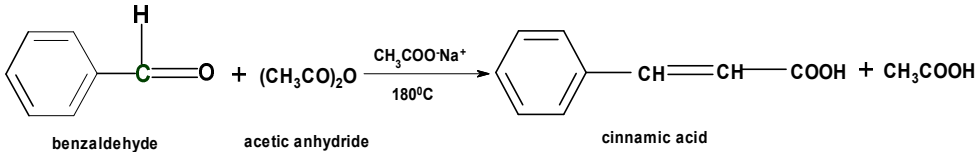
7. Complete the following nuclear reactions:

i) $^{14}_{7}N + \ldots\ldots \rightarrow {}^{17}_{9}F + {}^{1}_{0}n$ **ii)** $^{9}_{4}Be + {}^{2}_{1}H \rightarrow {}^{10}_{5}B + \ldots\ldots$

Ans:i) $^{4}_{2}He$ ii) $_{0}^{1}n$

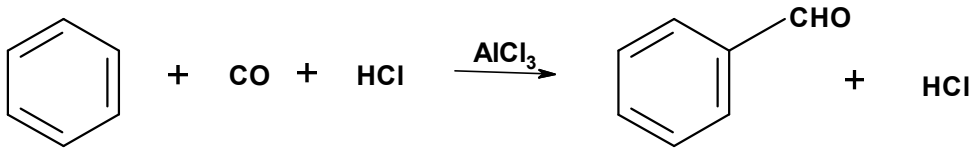
8. Explain Perkin Condensation with an example.

Ans: When benzaldehyde is heated with acetic anhydride in the presence of sodium acetate, cinnamic acid is formed.



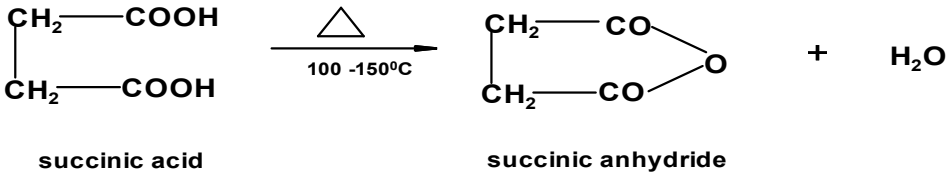
9. How is benzaldehyde obtained by Gattermann-Koch synthesis?

Ans: A mixture of carbon monoxide and HCl is passed through a solution of benzene in presence of anhydrous $AlCl_3$, under high pressure



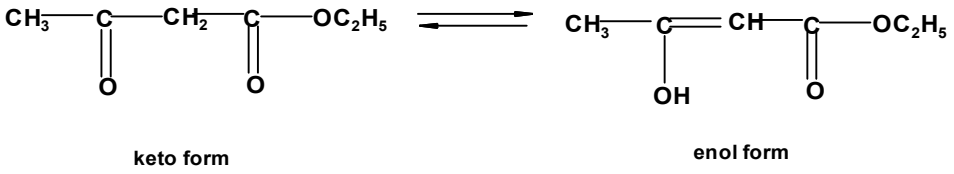
10.What is the action of heat on succinic acid, Explain with equation?

Ans: When succinic acid is heated, succinic anhydride is obtained by elimination of a water molecule.



11.Write the keto-enol form of ethyl acetoacetate.

Ans:**Keto-enol form of ethyl acetoacetate**:



12. What is Greenhouse Effect? Mention any two Greenhouse gases.

Ans: Green house effect:

Carbon dioxide, present in the earth's atmosphere, absorbs the outgoing infra red radiation. It becomes energetically excited and loses its energy partly by emission. A part of the emitted radiation goes to outer space and remaining part returns to earth's surface. An increase in concentration of CO2 due to deforestation and burning of forest fuels has led to a raise in earth's temperature. This effect of CO2 is known as greenhouse effect. The gases which cause greenhouse effect are CO2, methane,

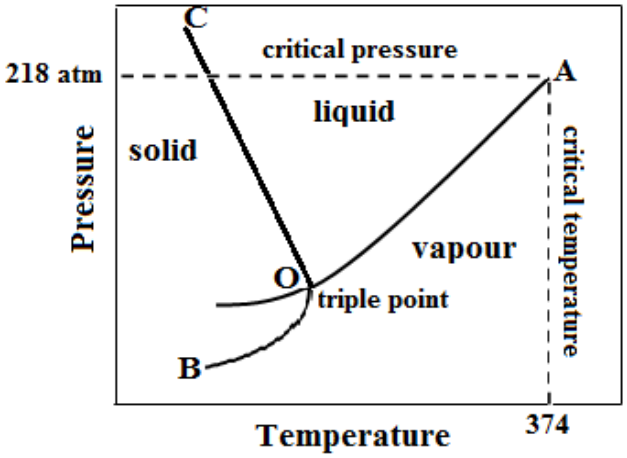
nitrous oxide, chlorofluorocarbons, etc (any two gases)

PART-B

Answer **any nine** of the following questions: 9x6=54)

13. a) Construct the phase diagram of water system and explain its salient features. 4m

Ans: The phase diagram of water system :



Salient features of the diagram

1. Three areas AOB, AOC and COB correspond to single phases of vapour, liquid and solid respectively.
2. The line OA is the vapour pressure curve of water. Above this line only liquid phase and below this line only vapour phase exists. A is the critical point.
3. Line OB is the sublimation curve of ice. It represents the solid-vapour equilibrium at different temperatures.
4. The line OC is the freezing point curve of water or melting point curve of ice. It gives the variation of melting point with temperature.
5. O is the triple point where the three phases co-exist.
   (any three features)

b) Mention the number of phases in the following systems: 2m

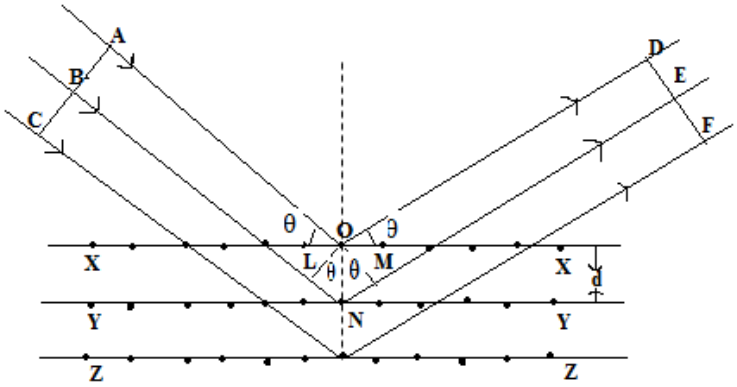
i) $H_{2(g)} + O_{2(g)} \rightarrow H_2O_{(g)}$

ii) $CaCO_{3(s)} \leftrightharpoons CaO_{(s)} + CO_{2(g)}$

Ans: i) Oneii) Two on thermal decomposition otherwise one.

14. a) Derive Bragg's equation, $n\lambda = 2d \sin\theta$.: 4m

Derivation of Bragg's equation



Consider a set of identical lattice planes XX, YY and ZZ, separated from one another by a distance d, in a crystal. Let a parallel beam of X-rays fall on these planes at a glancing angle θ. AO and OD are incident and reflected rays. Similarly BN and NE are the incident and reflected rays. Let OL and OM be the perpendiculars drawn to the incident and reflected rays. The second ray BN has to travel an extra distance of LN + NM compared to the first ray, known as the path difference between the two rays.

For constructive interference, the two rays have to be in phase with each other and this is possible only if the path difference between them is equal to integral multiple of the wavelength.

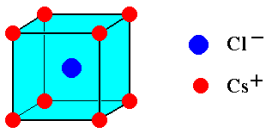
$$\text{i.e} LN + MN = n\lambda$$

since the triangles OLN and OMN are congruent, $LN = MN$

$$\therefore 2LN = n\lambda$$

$$\text{or } 2d\sin\theta = n\lambda$$

b) Sketch the unit cell of CsCl and indicate Cs^+ and Cl^- in it. **2m**



unit cell Cesium Chloride

15. a) Describe High temperature super conductors with suitable examples. 3m

Ans:High temperature super conductors: Super conducting materials having higher values of critical temperatures (Tc) are called high temperature super conductors. These are mostly alloys and possess better superconducting abilities. 1m

Examples: i) $Ba_2Ca_2Cu_3O_{2.33}$ ($T_c = 138$ K), ii)YBa_2CuO_7 ($T_c = 92$ K) 2m

b) Define number of degrees of freedom of a system. What is its value for an invariant system? 3m

Ans:**Number of degrees of freedom:** It is defined as the number of independent variables such as temperature, pressure and concentration which must be specified in order to define the system completely. For an invariant system, F = 0

16. a) Write a note on hardness of water. **3m**

Ans**:** Hardness of water: When water does not produce lather with soap properly, it is called hard water. Since soap will not lather in hard water, it is difficult to use such water for washing clothes and bathing. When utensils are washed in hard water, stains are left behind after drying. When hard water flows through pipes it deposits a scaly layer on the inner walls of the pipes and reduces the pipe's diameter. Even water heaters, washing machines, etc get scaled with hard water. Hardness of water is caused due to presence of dissolved salts of calcium and magnesium. Soap reacts with these salts and forms a sticky scum which makes a sticky deposit on skin and hair on bathing. The pH of hard water is more than 8.5.

The most common unit of measurement of water hardness is in parts per million (ppm) of calcium carbonate or milligrams of $CaCO_3$ per litre. Water containing up to 75 ppm of $CaCO_3$ is called soft water, up to 100 ppm is called hard water and up to 350 ppm, is called very hard water.Hard water can be rendered soft by methods like ion exchange process, nanofilteration and Reverse Osmosis.

b) What is powder metallurgy? Give any two advantages.3m

Ans:**Powder metallurgy and its two advantages:** Powder metallurgy is the technique of obtaining fine metallic powders of refractory metals like platinum, tungsten, molybdenum, etc.Advantages (any two):

1. Metals with high melting points like W, Mo, etc can be converted in to articles of desired shape
2. Allows for shape and material flexibility
3. Non-metallic substances or mutually insoluble metals can be shaped together
4. During shaping there is no wastage as metal scrap

17. a) Derive the relation $N = N_0e^{-\lambda t}$ for the decay of a radioactive element. **3m**

Ans: **Derivation of equation, $N = N_0e^{-\lambda t}$**

Consider a radioactive disintegration reaction: $A \rightarrow B$

Let N_0 be the number of atoms of A originally present and N be the number of atoms of A present at time t. Since the reaction is of first order, the rate of disintegration of A is given by,

$$-\frac{dN}{dt} = \lambda N \quad \ldots\ldots\ldots \text{Equation 1}$$

whereλ is known as the decay constant. Equation 1 can be written as,

$$-\lambda dt = \frac{dN}{N} \quad \ldots\ldots\ldots \text{Equation 2}$$

Integrating equation 2 we get,

$$\int \frac{dN}{N} = -\int \lambda dt$$

or$\ln N = -\lambda t + C \quad \ldots\ldots\ldots$.Equation 3

$$\text{at } t = 0, \quad N = N_0$$

$$\therefore \quad C = \ln N_0$$

substituting in equation 3 we get,

$$\ln N = -\lambda t + \ln N_0$$

$$\text{or } \ln\left[\frac{N}{N_0}\right] = -\lambda t$$

$$\text{or } N = N_0 e^{-\lambda t}$$

b) What is the role of a coolant in a nuclear reactor? Give two examples for a coolant?3m

Ans: Coolant and its examples**:**Coolant is a substance used in a nuclear reactor to dissipate the heat produced during a fission reactionExamples (any two): liquid sodium, heavy water, air, nitrogen, benzene, etc at high pressures.

18. a) Define the following with two examples for each: i) Isotopes ii) Projectiles.

Ans: **Definition of isotopes and projectiles:**

i) Isotopes: Isotopes are atoms of the same element having same atomic number but different mass numbers.Examples: $^{35}_{17}Cl$ and $^{37}_{17}Ci$, $^{1}_{1}H$ and $^{2}_{1}H$, etc (any two)

ii) **Projectiles:**Projectiles are particles used to bombard target nuclei during the artificial trans mutation of one nuclide in to anotherExamples: alpha particle, proton, deutron, neutron.

b) State Group displacement law.

Ans**: Group Displacement Law:Statement:**"The emission of an alpha particle results in the formation of an element which lies two places to the left of the parent element and the emission of a beta particle results in the formation of an element which lies one place to the right of the parent element in the periodic table"

19. a) Describe the production of tungsten powder from wolframite.

Ans: **Production of tungsten powder from wolframite:** **4m**

Concentration: The powdered ore [(Fe, Mn) WO_4] is concentrated by gravity method followed by electromagnetic separation

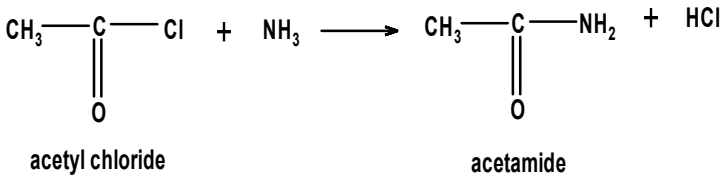
Roasting: The concentrated ore is fused with sodium carbonate in a reverb oratory furnace at 1000^0C to get sodium tungstate, Na_2WO_4

Treatment with HCl and Ammonia: Sodium tungstate is leached with water and dissolved. The insoluble oxides of Fe and Mn are filtered off. It is then treated with hot HCl when yellow tungstic acid, H_2WO_4 precipitates out. Tungstic acid is treated with ammonia to form a solution of ammonium paratungstate NH_4WO_4. The solution is then evaporated to dryness to get anhydrous oxide WO_3.

Reduction: WO_3 is reduced to tungsten powder at a temperature above 1000^0C. It is compacted and converted in to desired shape by heat treatment and sintering.

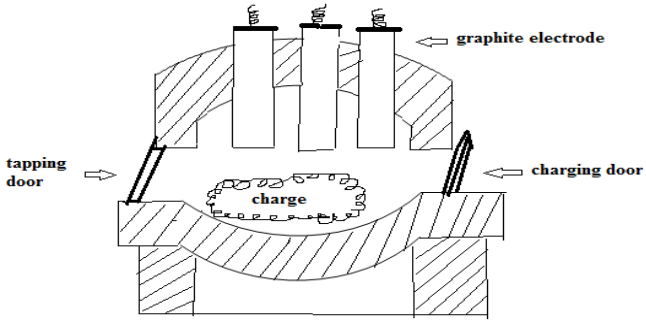
b) How does acetyl chloride react with ammonia? **2m**

Ans:Acetyl chloride reacts vigorously with ammonia to form acetamide



20. a) Describe the manufacture of ferrosilicon. **4m**

Ans: **Manufacture of ferrosilicon**:



The raw materials required are:1.Iron oxide (FeO) or haematite (Fe_2O_3) 2. Silica (SiO_2) 3.Coke. The electric furnace consists of a steel vessel lined with refractory bricks. Three movable water jacketed graphite electrodes are suspended from the top.The charge is introduced into the furnace. An electric arc is struck between the electrodes. Ferrosilicon is formed at high temperature. The impurities form a slag which is tapped out. The molten alloy is also tapped out of the furnace.

$$FeO + SiO_2 + 3C \rightarrow \underset{\text{ferrosilicon}}{(Fe + Si)} + 3CO$$

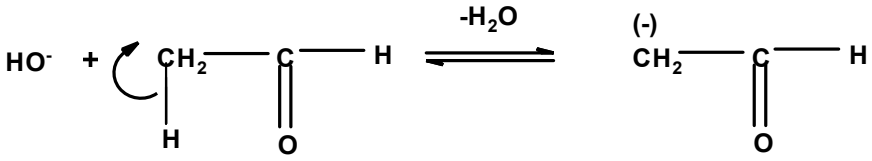
b) What is Austenite? Mention its properties. **2m**

Ans: **Austenite and its properties:**Austenite is one of the phases of steel which is a solid solution of about 2% carbon in γ iron. It is soft, non-magnetic, has afcc lattice and possesses considerable tensile strength, ductilityand malleability.

21. a) Explain the mechanism of Aldol Condensation.4m

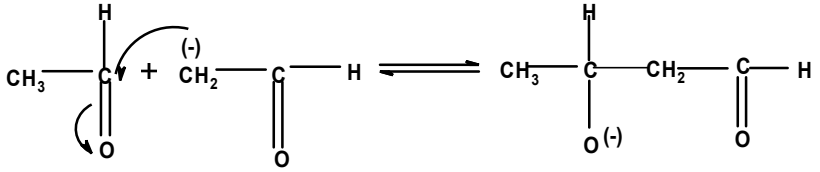
Ans:**Mechanism of aldol condensation**:Aldehydes containing α-hydrogen undergo a reversible self-addition in presence of dilute base to give condensation product called 'aldol', which contains both aldehyde and alcohol functional groups. This is called aldolcondensation. The mechanism can be explained as follows taking acetaldehyde as an example.

a) The base ionises to form OH^- ion which removes a proton from the α–carbon forming a carbanion (I)



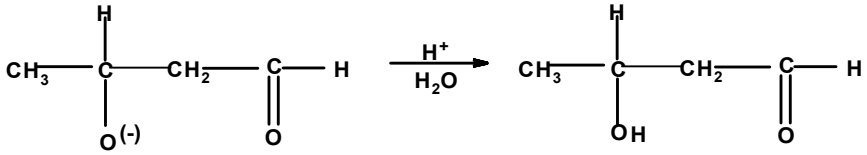
carbanion (I)

b) The carbanion attacks the carbonyl carbon of another aldehyde forming the anion(II)



(II)

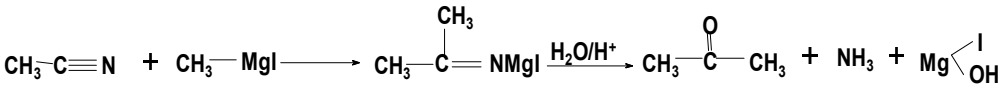
c) Anion (II) accepts a proton from H_2O to form aldol



Aldol

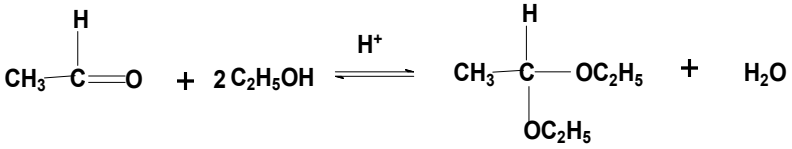
b) How is acetone obtained from methyl cyanide? 2m

Ans**: Acetone from methyl cyanide:**Methyl magnesium iodide adds on to methyl cyanide to give an addition product, which upon subsequent acid hydrolysis results in formation of acetone



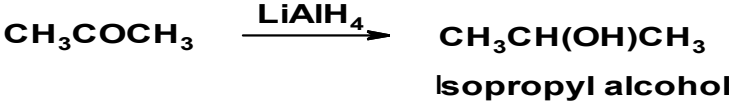
22. a) Explain the reactions of: i) Acetaldyhyde with ethanol ii) Acetone with $LiAlH_4$

Ans:**i) Reaction of acetaldyhyde with ethanol:**Acetaldehyde when treated with an anhydrous ethanol in the presence of an anhydrous acid forms acetal**4m**



Acetaldhehyde Acetal

ii) Reaction of acetone with $LiAlH_4$: Acetone is reduced by $LiAlH_4$ to a secondary alcohol, isopropyl alcohol



Isopropyl alcohol

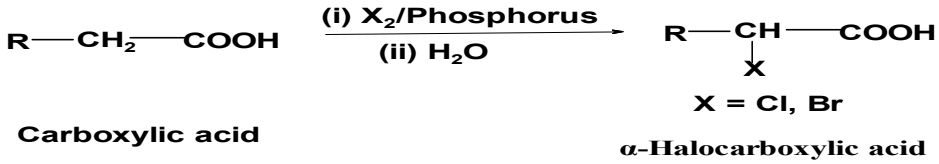
b) How is acetyl chloride converted to acetaldehyde? 2m

Ans: Acetyl chloride is heated with Hydrogen gas in presence of the catalyst Palladium deactivated using barium sulphate, acetaldehyde is formed. This reaction is called Rosenmund's reduction.

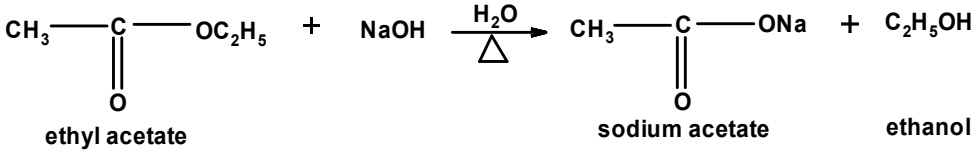
$$CH_3\text{-}CO\text{-}Cl + H_2 \xrightarrow{\text{Pd/BaSO}_4,\ \Delta} CH_3\text{-}CHO + HCl$$

23. a) Write notes on: i) Hell-Vollhard-Zelinski reaction? ii) saponification reaction. 4m

Ans:**i) Hell-Vollhard-Zelinski reaction:**Carboxylic acids having an α-hydrogen are halogenated at the α-position to give α-halo carboxylic acids on treatment with chlorine or bromine in the presence of a small amount of red phosphorus

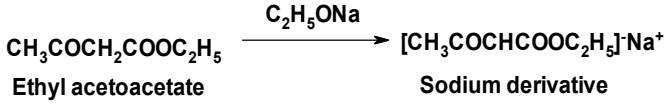


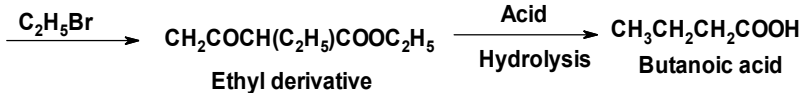
Saponification reaction: Alkaline Hydrolysis of an ester that is ester is heated with a strong alkali like sodium hydroxide, resulting in the formation of parent alcohol and sodium salt of the carboxylic acid is called saponification reaction.
Example:



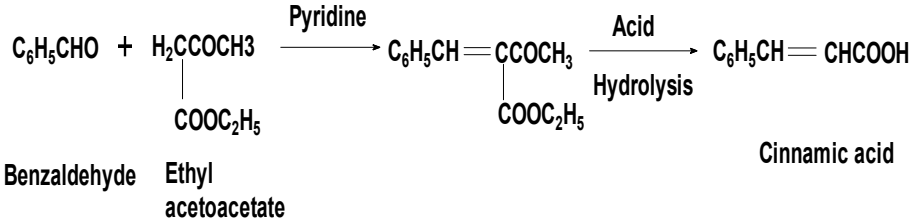
b)Arrange the following in the increasing order of acid strength. 2m
CH_3COOH, $Cl_2CHCOOH$, $ClCH_2COOH$, Cl_3CCOOH.
Ans: Increasing order of acid strength**:**
i) CH_3COOH ii) $ClCH_2COOH$ **iii)** $Cl_2CHCOOH$ **iv)** Cl_3CCOOH

24. a) How are following compound prepared from ethyl acetoacetate? 4m
i) Butanoic acid and ii)Cinnamic acid
Ans:**Preparation of Butanoic acid**:Ethyl acetoacetate when treated with sodium ethoxide and ethyl bromide followed by acid hydrolysis gives butanoic acid





ii) **Cinnamic acid:**Ethyl acetoacetate condenses with benzene in presence of pyridine to give cinnamic acid



b) Differentiate between tautomerism and resonance? 2m
Ans:Tautomerism: Tautomerism is a phenomenon in which isomers of a compound having different molecular structures exist in dynamic equilibrium.

Resonance: Whenever a molecule can be represented by two or more structures which differ from one another in the arrangement of electrons, the molecule is said to involve resonance. The molecule is said to be a resonance hybrid of all these canonical structures.

25. a) Describe the different stages of sewage treatment. 4m

Ans:Treatment of sewage : Sewage consists of wastes from residences, industries and institutions. Itcontains suspended as well as dissolved wastes which are both organic and inorganic in nature. Treatment consists of three stages:

Primary treatment: In this stage suspended matter such as paper, wood, glass, etc are removed by filtration. The waste water is then let in to sedimentation tank when solid matter settles down. Colloidal particles are removed

Secondary treatment: The sewage is passed through tickling filters embedded with active microorganisms called activated sludge. In presence of oxygen the organic wastes undergo aerobic oxidation and biological degradation.

Tertiary treatment: Here nondegradable wastes like heavy metals, pesticides, insecticides, etc are removed by using methods like chemical coagulation, filtration, ion-exchange, electro dialysis, reverse osmosis, etc

b) Define Biochemical Oxygen Demand. 2m

Biochemical Oxygen Demand is the quantity (or mg/ml) of oxygen required by the bacteria and other microorganisms during the biochemical degradation and transformation of organic matter present in waste water under aerobic conditions

IV Semester B.Sc. Examination (CBCS)
CHEMISTRY (Paper-IV)-Model Paper- 2
Chemistry-IV

Time: 3 Hours Max.Marks: 70

Instructions: 1) The question paper has two parts. Answer both the parts.
2) Draw diagrams and write chemical equations wherever necessary.

PART-A

Answer **any eight** of the following questions: (8x2=16)

1. Define the term number of components of system.
2. What is a freezing mixture? Give an example.
3. State the law of rational indices.
4. Name any four biological contaminants present in water.
5. Write a brief note on hardening of steel.
6. Name any two nuclear reactors in India and mention their locations.
7. Calculate the half-life period of a radioactive element whose decay constant is 9.78×10^{-10} $year^{-1}$.
8. Give an example for Wolf-Kishner reduction.
9. How does acetone react with hydroxylamine?
10. Write the structural formula of citric acid and give its basicity.
11. How is ethyl acetate converted to ethyl acetoacetate?

12.What is stone leprosy?

PART-B

Answer **any nine** of the following questions: 9x6=54)

13. a) Draw a labeled phase diagram of lead-silver system. Identify the eutectic point. What is the composition at this point?
b) Calculate the number of components and number of degrees of freedom in an aqueous solution of glucose. (4+2)

14. a) Define centre of symmetry in a crystal. The Weiss indices of a crystal is 321 convert into Miller indices
b) Write a note on smectic liquid crystals. (4+2)

15. a) Describe the desilverization of lead by Pattinson's Process.
b) Calculate the angle at which first order reflection will occur when X-rays of wave-length 1.54 Å are diffracted by the angles of a crystal, given that interplanar distance is 4.04 Å. (3+3)

16. a) How is Reverse Osmosis used to treat water for industrial and domestic purposes.
b) Give two methods of obtaining metal powders. (4+2)

17. a) Differentiate between nuclear fission and nuclear fusion with an example for each.
b) Write a note on radioactive carbon dating. (3+3)

18. a) Explain the construction and working of GM Counter in detection and measurement of radioactivity.
b) Give two applications of radioactive tracers in medicine.(4+2)

19. a) What is meant by sintering? Give any two applications of powder metallurgy.
b) pKa value of acetic acid is greater than formic acid. Give reason.(4+2)

20. a) What are alloy steels? Name any two alloy steels, give their composition and properties.
b) Explain nitriding of steel.(4+2)

21. a) Explain the mechanism of Benzoin Condensation.
b) What is Mannich reaction**?** Give an example**.** (4+2)

22. a) Explain with suitable examples: i) Knoevenagel condensation,
ii) Clemmensen reduction.
b) Give one example for preparation of ketones from carboxylic acids.

(4+2)

23. a) Describe the action of heat on the following: i) Oxalic acid, ii)Malonic acid.
b) What is Hofmann Rearrangement?(4+2)

24. a) Explain the term "active methylene compounds". Give two examples. Mention their significance in organic chemistry?
b) What happens when diethyl malonate reacts with urea?(4+2)

25. a) Write a note on depletion of ozone layer in the atmosphere.
b) Mention any two consequences of photochemical smog?(4+2)

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IV Semester B.Sc. Examination (CBCS)
CHEMISTRY (Paper-IV
Chemistry-IV- Model Paper- 2-Key Answers

Time: 3 Hours Max.Marks: 70

Instructions: 1) The question paper has two parts. Answer both the parts.
2) Draw diagrams and write chemical equations wherever necessary.

PART-A

Answer **any eight** of the following questions: (8x2=16)

1. Define the term number of components of system.

Ans:"The smallest number of independently variable chemical species necessary to describe the composition of each and every phase of the system by means of a chemical equation".

2. What is a freezing mixture? Give an example.

Ans:**Freezing mixture:** A mixture of substances, usually salt and ice, having a temperature below freezing point of water **Examples (any one): i)** NaCl + ice**, ii)** NH_4Cl + ice

3. State the law of rational indices.

Ans: **Law of rational indices:** "Intercepts of any face of a crystal along the crystallographic axes are either equal to the unit intercepts (a,b,c) or their whole number multiples".

4. Name any four biological contaminants present in water.

Ans**:** Biological contaminants present in water (any four)**:**Living organisms like algae, bacteria, protozoa, pathogens, microbes, viruses, parasites and their eggs (cysts).

5. Write a brief note on hardening of steel.

Ans**: Hardening of steel:**The process of heating steel to redness and suddenly cooling it by immersion in oil or water bath. This process makes the steel more hard and brittle.

6. Name any two nuclear reactors in India and mention their locations.

Ans:**Nuclear reactors in India and their locations (any two):**i) Apsara at BARC, Trombay ii) Cirus at BARC, Trombay, iii) Tarapur Atomic Power Station (TAPS) at Tarapur,Maharashtra iv) Narora Atomic Power Station (NAPS) at Narora, Uttar Pradesh, etc

7. Calculate the half-life period of a radioactive element whose decay constant is 9.78 x$10^{-10}$$yr^{-1}$

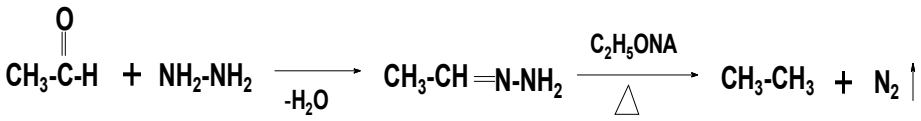
Ans: Calculation of half-life period:

$$t_{1/2} = \frac{0.6931}{\lambda}$$

$$= \frac{0.6931}{9.78 \times 10^{-10}\ year^{-1}} = 7.09 \times 10^{8}\ years.$$

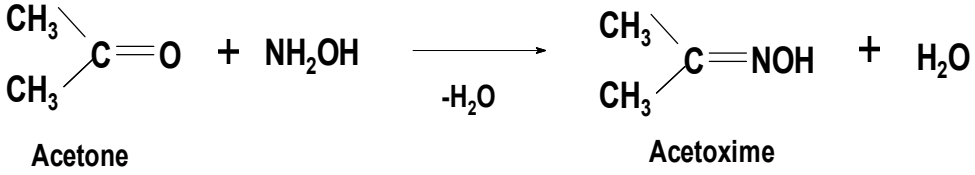
8. Give an example for Wolf-Kishner reduction.

Ans: **Example for Wolff-Kishner reduction:**Reduction of aldehyde or ketone in presence of hydrazine and sodium ethoxide.



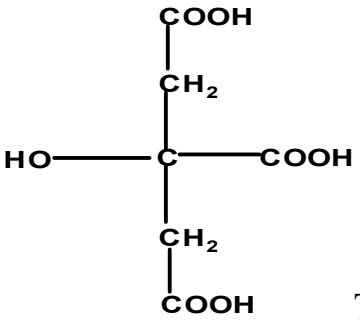
9. How does acetone react with hydroxylamine?

Ans**:** Acetone reacts with hydroxylamine forming acetoximde due to condensation reaction.



10. Write the structural formula of citric acid and give its basicity.

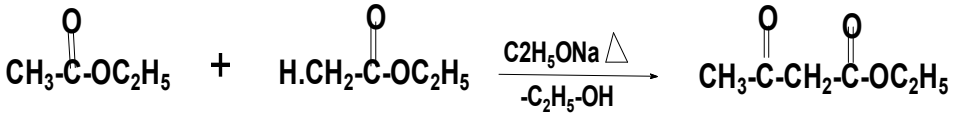
Ans: Structural formula of citric acid and its basicity:



The basicity of citric acid = 3

11. How is ethyl acetate converted to ethyl acetoacetate?

Ans: **Conversion of ethyl acetate to ethyl acetoacetate:** Two molecules of ethyl acetate on condensation in presence of sodium ethoxide in ethanol followed by acidification give ethyl acetoacetate.



12. What is stone leprosy?

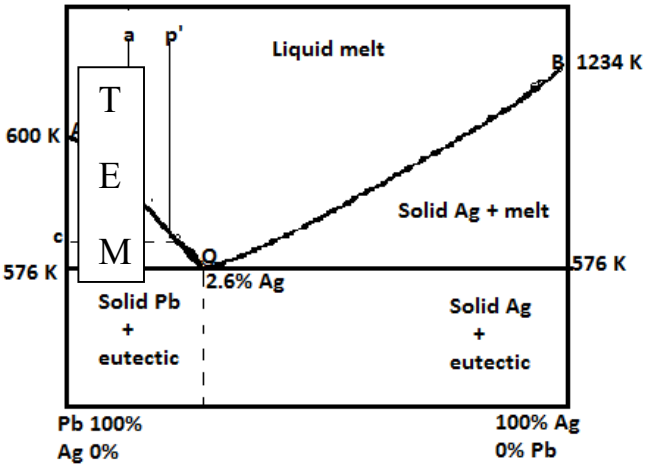
Ans: **Stone leprosy:** When acid rain which has a pH of less than 5.6 falls on marble buildings, it damages the marble due to which the surface of buildings acquires a pitted, corroded appearance. This is known as stone leprosy.

PART-B

Answer **any nine** of the following questions: 9x6=54)

13. a) Draw a labeled phase diagram of lead-silver system. Identify the eutectic point. Whatis the composition at this point? 4m

Ans:**phase diagram of lead-silver system**



Composition

O is the eutectic point and the eutectic composition is 97.6% Pb and 2.4% Ag

b) Calculate the number of components and number of degrees of freedom in an aqueous solution of glucose. **2m**

Ans:In Aqueous solution of glucose:Here C = 2**;** Since P = 1**,**
Then, F = C – P + 1 = 2 – 1 + 2 = 3

14. a) Define centre of symmetry in a crystal. The Weiss indices of a crystal is 321 convert into Miller indices. **4m**

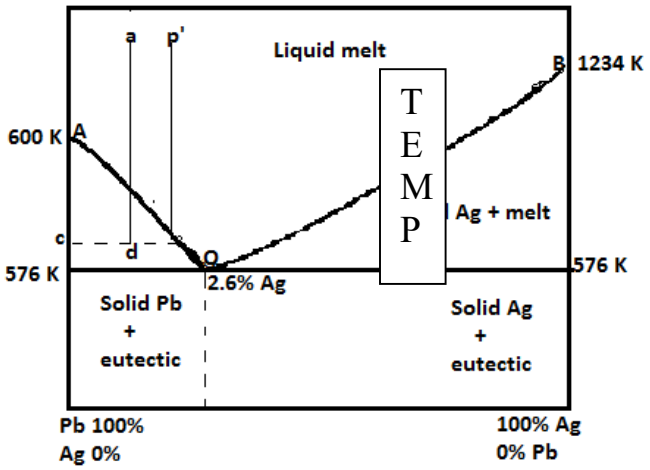
Ans**: Centre of symmetry:** It is a point such that any line drawn through it intersects the surface of the crystal at equal distances in both directions.**2m**
Reciprocals of Weiss indices: 1/3,/1/2., 1/1. Multiplied by the simple whole number 6, we get the miller indices: 1/3x6, 1/2x6, 1/1x6 = 236**2m**

b) Write a note on smectic liquid crystals. **2m**

Smectic liquid crystals: Smectic means soapy. These have layered structure with well-defined interlayer spacing. The layers slide over each other. Smecticphase has a complex structure and a fan like appearance. They are not affected by a magnetic field.
Eg: Ethyl-p-azoxybenzoate, Ethyl-p-azoxy-cinnamate

15. a) Describe the desilverization of lead by Pattinson's Process. **3m**

Ans**:Desilverization of lead by Pattinson's Process:**The process of increasing relative proportion of silver in argentiferous lead is known as desilverization of lead. In Pattinson's process, argentiferous lead which contains about 0.1% silver is first heated to a temperature well above its melting point, so that the system consist of only liquid phase. It is then allowed to cool. As the temperature of the melt falls, lead will begin to crystallize out and the solution



will contain relatively increasing amount of silver. As cooling is continued,lead continues to separate out and is constantly removed by means of ladles. The melt continues to be richer and richer in silver, until at the end of the process, the percentage of silver raises to about 2.6

b) Calculate the angle at which first order reflection will occur when X-rays of wave-

length 1.54 Å are diffracted by the angles of a crystal, given that interplanar distance is 4.04 Å. **3m**

Ans: **Problem:** $2d\sin\theta = n\lambda$

For first order diffraction, n = 1

$$\therefore \quad 2d\sin\theta = \lambda$$

$$\therefore \quad \theta = \sin^{-1}\left(\frac{\lambda}{2d}\right)$$

$$\theta = \sin^{-1}\left(\frac{1.54\text{Å}}{8.08\text{Å}}\right)$$

$$\theta = \sin^{-1}(0.191) = 10^{0}59'$$

16. a) How is Reverse Osmosis used to treat water for industrial and domestic purposes. **4m**

Ans: **Reverse Osmosis:** Osmosis is the spontaneous flow of solvent in to a solution or from a less concentrated solution to a highly concentrated solution, when the two liquids are separated by means of a semipermiable membrane. Osmosis can be made slow, stopped or even reversed if sufficient pressure is applied on the concentration solution side of the membrane. If pressure greater than the osmotic pressure is applied, then osmosis is forced to proceed in the reverse direction, that is from the solution to solvent side. The process is known as Reverse Osmosis. Reverse Osmosis has a number of applications such as purification of drinking water, demineralization of hard water, desalination of sea water, etc.The process of Reverse Osmosis is shown in the figure. Fresh water (solvent) is kept on one side of the semipermeable membrane and solution to be purified/deionised on the other. Pressure is exerted on the side of the solution to force the water molecules across the membrane towards the fresh water side.

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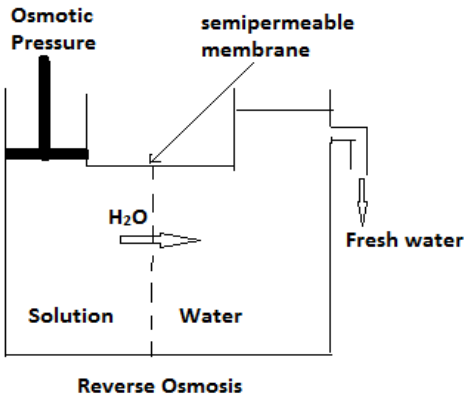


b) Give two methods of obtaining metal powders. **2m**

Ans: **Two methods of obtaining metal powders:**

1. By thermal decomposition of metal carbonyls. Example : $Ni(CO_4) \rightarrow Ni + 4CO\uparrow$
2. By reduction of metal oxides. Example: $CuO + H_2 \rightarrow Cu + 2H_2O$

17. a) Differentiate between nuclear fission and nuclear fusion with an example for each. 3m

Ans**: Difference between nuclear fission and nuclear fusion:**The splitting of a heavy nucleus in to two smaller fragment of approximately equal mass is known as nuclear fission

Example: $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{141}_{56}Ba + ^{92}_{36}Kr + 3\,^{1}_{0}n$(or any suitable example)

Formation of a heavier nucleus from lighter nuclei, along with the release of enormous amount of energy is known as nuclear fusion.

Example: formation of helium nucleus from hydrogen nuclei:

$^{1}_{1}H + ^{2}_{1}H \rightarrow ^{3}_{2}He$(or any other suitable example)

b) Write a note on radioactive carbon dating. 3m

Ans**: Carbon dating**: The concentration of radioactive ^{14}C in all living organisms is constant during their lifetime. But once the organism dies, the concentration of ^{14}C goes on decreasing with time since CO_2 is no longer consumed by the organism. By carefully measuring the decay rate of ^{14}C in a sample of dead organic matter, the age of the sample can be calculated. This technique of dating objects by measuring the radioactivity of ^{14}C is known as radiocarbon dating.$_7{}^{14}N + {}_0n^1 \rightarrow {}_6{}^{14}C + P({}_1H^1)$,where n represents a neutron and p represents a proton.Carbon 14 is continually being formed in the upper atmosphere by the effect of cosmic ray neutrons on nitrogen 14 atoms. It is rapidly oxidized in air to form carbon dioxide and enters the global carbon cycle. Plants and animals assimilate carbon 14 from carbon dioxide throughout their lifetimes. When they die, they stop exchanging carbon with the biosphere and their carbon 14 content then starts to decrease at a rate determined by the law of radioactive decay.C14 is a beta emitter, as age proceeds its beta emission number decreases. by measuring the number of beta particles emitted by the fresh sample of wood the age is

calculated using the equation: Age(t) of the sample = 19142 $\log(N_o/N_t)$. Where N_o is the number of beta particles emitted by the freshly cut sample of wood(15.3), N_t is the number of beta particles emitted by the wood at the time of measurement of the age(which is measured using a GM counter).

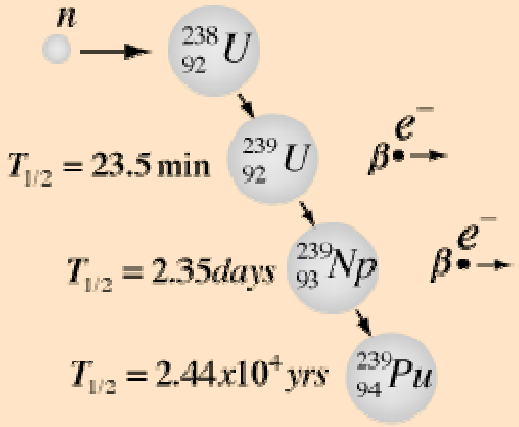
18. a) What are Breeder reactors? Explain briefly the functioning of abreeder reactor. 4m

Ans: A **Breeder Reactor** is a nuclear reactor that "breeds" fuel. A Breeder consumes fissile and fertile material at the same time as it creates new fissile material. Production of fissile material in a reactor occurs by neutron irradiation of fertile material, particularly Uranium-238 and Thorium-232. In a breeder reactor, these materials are deliberately provided, either in the fuel or in a **Breeder Blanket** surrounding the core, or most commonly in both. Production of fissile material takes place to some extent in the fuel of all current commercial nuclear power reactors. Towards the end of its life, a uranium PWR fuel element is producing more power from the

fissioning of plutonium than from the remaining uranium-235. Historically, in order to be called a ***breeder,*** a reactor must be specifically designed to create more fissile material than it consumes. Under appropriate operating conditions, the neutrons given off by fission reactions can "breed" more fuel from otherwise non-fissionable isotopes. The most common breeding reaction is that of plutonium-239 from non-fissionable uranium-238. This scenario is possible because the non-fissionable uranium-238 is 140 times more abundant than the fissionable U-235 and can be efficiently converted into Pu-239 by the neutrons from a fission chain reaction.

Ex: Breeding Plutonium-239

Fissionable plutonium-239 can be produced from non-fissionable uranium-238 by the reaction illustrated.



The bombardment of uranium-238 with neutrons triggers two successive beta decays with the production of plutonium. The amount of plutonium produced depends on the breeding ratio.

b) Give two applications of radioactive tracers in medicine. **2m**

Ans**: Two applications of radioactive tracers in medicine**

i)^{34}P is used to check absorption of phosphorus by bones and also to detect bone fracture

ii)^{24}Na is used to follow the flow of blood so that obstructions in the circulatory system can be located

19. a) What is meant by sintering? Give any two applications of powder metallurgy. 4m

Ans**: Sintering:** Sintering is an important stage in powder metallurgy, which is carried out by heating the compacted powder to a temperature below the melting point of the metal under controlled pressure or vacuum.During sintering a strong bond is formed between particles. Certain chemical changes, phase changes and changes in electrical properties may also occur

Applications of powder metallurgy (any two): **1.** Cemented carbides of W and Mo in matrix of nickel, made by PM are used as cutting tools. **2.** Uranium carbide and Uranium dioxide made by PM are used as nuclear fuels while beryllium powder is used as a moderator in nuclear reactors.Self lubricating bearings containing porous sintered parts obtained by PM are used in automobiles, washing machines, air conditioners, refrigerators etc.,.

b) pKa value of acetic acid is greater than formic acid. Give reason. **2m**

Ans:The methyl group in acetic acid is electron releasing. It increases the negative charge on the resulting carboxylate anion, destabilizing it and thus decreasing the acid strength. Hence acetic acid weaker than formic acid.

20. a) What are alloy steels? Name any two alloy steels, give their composition and properties. 4m

Ans**: Alloy steels:**Alloy steels are steels containing specified amounts of elements like Cr, V, W, Mn,Ni, Si, Mo, Co, etc. The alloying elements impart special propertied to steel.

Some alloy steels, their composition and properties (any two):

Name	Composition	Properties
Silicon steel	5% Silicon	Hard and resistant to wear, high electrical resistance
Manganese steel	9 – 14% Manganese	Very hard, resistant to wear and abrasion
Nickel steel	2 -4 % Nickel	Resists corrosion, hard and elastic

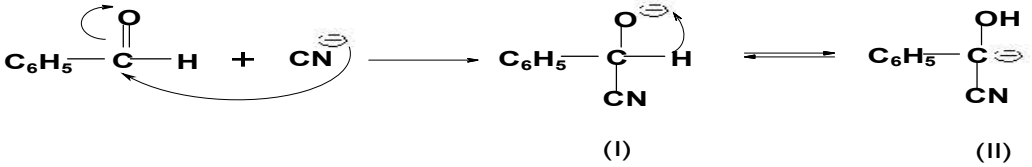
(or any two other suitable alloy steels)

b) Explain nitriding of steel. 2m

Ans**: Nitriding of steel:** Steel is heated in an atmosphere of ammonia to a temperature of about 500 – 550^{0}C. Atomic nitrogen produced by partial dissociation of NH_3, diffuses in to the surface and gets converted in to hard metal nitrides. Nitrided surface is more resistant to corrosion and retains hardness even at high temperatures. Nitrided steel is used to make parts of guns, dies, etc.

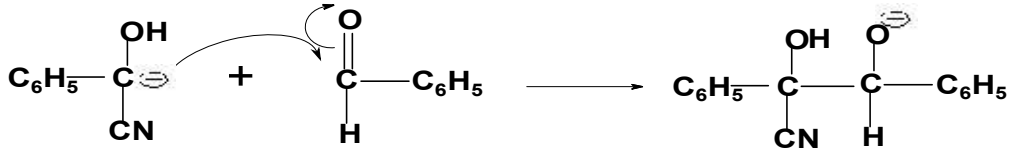
21. a) Explain the mechanism of Benzoin Condensation. 4m

Ans**: Mechanism of Benzoin Condensation: Step** 1: Nucleophylic addition of CN^- to the carbonyl carbon of the benzaldehyde molecule resulting in the formation of anion (I) which undergoes proton transfer giving carbanion (II)

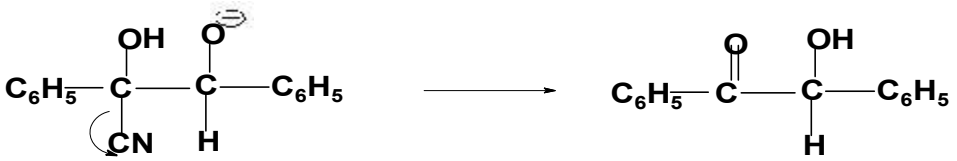


(I) (II)

Step 2: Resonance stabilized carbanion adds on to the carbonyl group of another benzaldehyde molecule



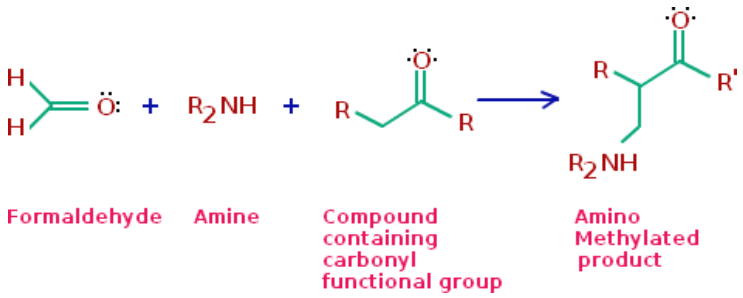
Step 3: Proton migration from –OH followed by the abstraction of cyanide anion to give benzoin



b) What is Mannich reaction? Give an example. **2m**

Ans: The Mannich reaction is an organic reaction used to convert a primary or secondary amine and two carbonyl compound (one non-enolizable and one enolizable) to a β-amino carbonyl compound, also known as a Mannich base, using an acid or base catalyst.

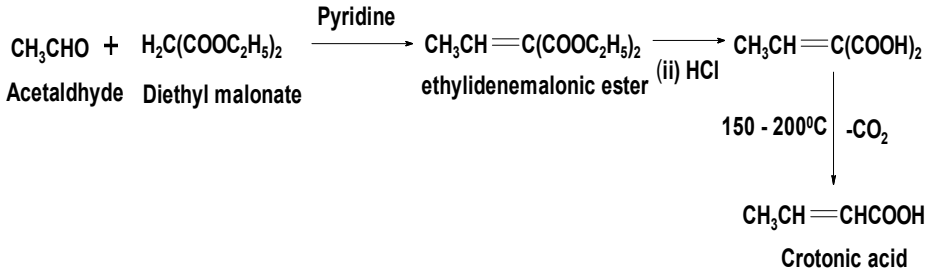
Example: R= CH_3



22. a) Explain with suitable examples: i) Knoevenagel condensation, ii) Clemmensen reduction. **4m**

Ans: **i) Knoevenagelcondensation:**Nucleophyllic addition of an active hydrogen compound to the carbonyl group in the presence of an organic base like pyridine, followed by hydrolysis and decarboxylation, resulting in the formation of an α,β – unsaturated acid

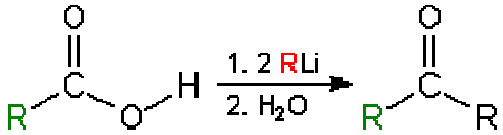
Example:



ii) Clemmensen reduction: It is the reduction aldehydes or ketones to corresponding hydro-carbons by heating zinc amalgam and hydrochloric acid as reducing agent.

b) Give one example for preparation of ketones from carboxylic acids. **2m**

Ans: Carboxylic acids are heated with alkyl lithium followed by hydrolysis ketones are obtained

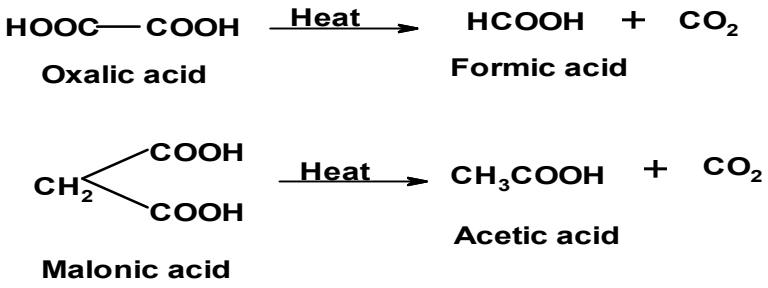


Ex: Ethanoic acid is treated with methyl lithium followed by acid hydrolysis yields propanone a ketone: CH_3COOH ----CH_3Li/H_2O---→ CH_3COCH_3 + LiOH.

(or any other example)

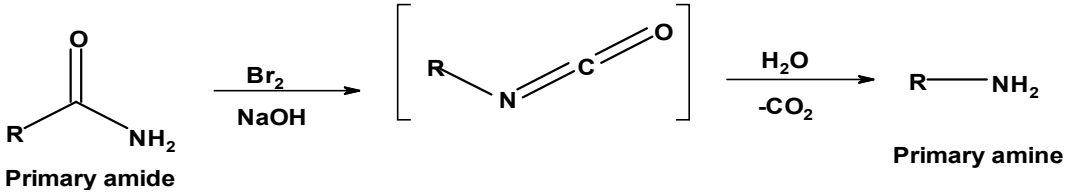
23. a) Describe the action of heat on the following: i) Oxalic acid, ii)Malonic acid.4m

Ans:**Action of heat on oxalic acid and malonic acid:** Whenever two carboxyl groups are attached to the same carbon atom, the compound on heating loses carbon dioxide and thus one of the carboxyl groups is eliminated.Oxalic and malonic acids lose a molecule of CO_2 and form monocarboxylic acids



b) What is Hofmann Rearrangement? 2m

Ans**: Hofmann Rearrangement:** When a primary amide is treated with bromine in alkaline solution, it is converted in to a primary amine by the elimination of carbonyl group.

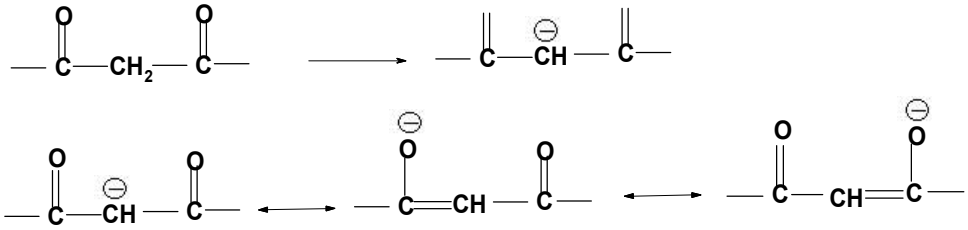


The reaction is called as Hofmann Rearrangement

24. a) Explain the term-'active methylene compounds'. Give two examples.Mentiontheir significance in organic chemistry? 4m

Ans**: Active methylene compounds, examples and their significance:** When a methylene group is flanked by two carbonyl or similar groups, the hydrogens on the methylene carbon

will be highly acidic because the resulting carbanion would be resonance stabilized to a greater extent, as shown below:

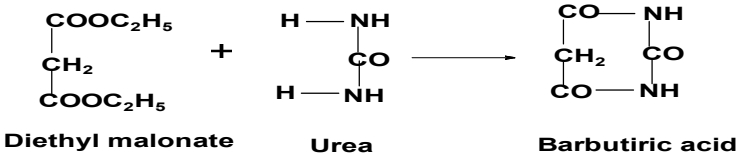


Such a methylene group is called an active methylene group and compounds.*Examples:* $CH_2(COOC_2H_5)_2$ (Diethyl malonate), $CH_3COCH_2COOC_2H_5$ (Ethyl acetoacetate)

Significance: These compounds are extremely important synthetic reagents in organic chemistry. They are used to synthesise mono and dicarboxylic acids, ketones, etc.

b) What happens when diethyl malonate reacts with urea? 2m

Ans: Reaction of diethyl malonate with urea: When diethyl malonate reacts with urea barbituric acid is formed



Diethyl malonate Urea Barbutiric acid

25. a) Write a note on depletion of ozone layer in the atmosphere. 4m

Ans:**Depletion of ozone layer in the atmosphere:** Ozone is present in the stratosphere of earth and it plays a critical role in absorbing ultraviolet radiation emitted by the sun.

$$h\nu + O_2 \rightarrow 2O$$

$$O_2 + O \rightarrow O_3$$

$$O_3 + h\nu \rightarrow O_2 + O$$

In the last thirty years, this stratospheric ozone is depleting as a result of anthropogenic pollutants called Ozone Depleting Substances (ODSs). Of these substances, the most important are chloroflouro carbons (CFCs). CFCs are highly stable and when they reach the stratosphere they react with high energy photons and release their individual components, that is radicals of chlorine and fluorine, which cause the catalytic destruction of ozone

$$Cl + O_3 \rightarrow ClO + O_2$$

$$ClO + O \rightarrow Cl + O_2$$

The consequences of delpleted ozone are sunburn, skin cancer, cataracts, damage to plants, reduction of plankton population, etc, which results due to increased exposure to UV radiation. The ozone depletion generated worldwide concern leading to adoption of Montreal Protocol which bans the production of CFCs, halons and other ozone depleting chemicals like CCl_4 and trichloroethane.

b) Mention any two consequences of photochemical smog? 2m

Ans**: Consequences of photochemical smog (any two):**

1. Causes lung diseases like bronchitis and astama
2. Causes eye irritations and affects nose and throat
3. Interferes with the body's ability to fight infection

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