

2015 CBSE OUTSIDE DELHI

Time allowed: 3 hours

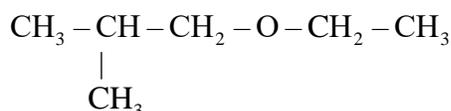
Maximum Marks: 70

General Instructions:

- (i) All questions are compulsory.
- (ii) Q. no. 2 to 5 are very short-answer questions and carry 1 mark each,
- (in) Q. no. 6 to 10 are short-answer questions and carry 2 marks each.
- (iv) Q. no. 11 to 22 are also short-answer questions and carry 3 marks each.
- (v) Q. no. 23 is a value based question and carry 4 marks.
- (vi) Q. no. 24 to 26 are long-answer questions and carry 5 marks each.

General Instructions:

1. Write the formulae of any two oxoacids of Sulphur.
2. Write the IUPAC name of the given compound:



3. A delta is formed at the meeting point of sea water and river water. Why?
4. Which would undergo S_N1 reaction faster in the following pair:

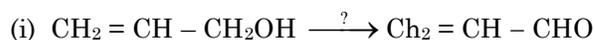


5. What is the formula of a compound in which the element Y forms *ccp* lattice and atoms of X occupy $2/3^{\text{rd}}$ of tetrahedral voids?
6. Write one similarity and one difference between the chemistry of lanthanoids and that of actinoids.
- 7.

(i) Write down the IUPAC name of the following complex: $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$

(ii) Write the formula for the following complex:
Potassium tetrachloridonickelate (II)

8. Write the reagents required in the following reactions:



OR

Arrange the following compounds in increasing order of their property as indicated:

(i) CH_3COCH_3 , $\text{C}_6\text{H}_5\text{COCH}_3$, CH_3CHO (reactivity towards nucleophilic addition reaction)

(ii) $\text{Cl} - \text{CH}_2 - \text{COOH}$, $\text{F} - \text{CH}_2 - \text{COOH}$, $\text{CH}_3 - \text{COOH}$ (acidic character)

9. (i) On mixing liquid X and liquid Y, volume of the resulting solution decreases. What type of deviation from Raoult's law is shown by the resulting solution? What change in temperature would you observe after mixing liquids X and Y?

(ii) What happens when we place the blood cell in water (hypotonic solution)? Give reason.

10. Calculate the time to deposit 1.27 g of copper at cathode when a current of 2A was passed through the solution of CuSO_4 . (Molar mass of Cu = 63.5g mol^{-1} , 1 F = 96500 C mol^{-1}).

11. A solution is prepared by dissolving 10g of non-volatile solute in 200g of water. It has a vapour pressure of 31.84 mm Hg at 308K. Calculate the molar mass of the solute. (Vapour pressure of pure water at 308K = 32 mm Hg)

12. (i) Name the method of refining to obtain silicon of high purity.

(ii) What is the role of SiO_2 in the extraction of copper?

(iii) What is the role of depressants in froth floatation process?

13. (i) Which one of the following is a polysaccharide: starch, maltose, fructose, glucose

(ii) Write one difference between α -helix and β -pleated sheet structures of protein.

(iii) Write the name of the disease caused by the deficiency of vitamin B₁₂.

14. (i) What type of isomerism is shown by the complex $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$?

(ii) On the basis of crystal field theory, write the electronic configuration for d⁴ ion if $\Delta_0 > P$.

(iii) Write the hybridization and shape of $[\text{CoF}_6]^{3-}$.
(Atomic number of Co = 27)

15. How can the following conversions be carried out:

- Aniline to bromobenzene
- Chlorobenzene to 2-chloroacetophenone
- Chloroethane to butane

OR

What happens when

- chlorobenzene is treated with $\text{Cl}_2/\text{FeCl}_3$,
- ethyl chloride is treated with AgNO_2 ,
- 2-bromopentane is treated with alcoholic KOH ?

Write the chemical equations in support of your answer.

16. Examine the given defective crystal:

3

| | | | | |
|--------------|--------------|--------------|--------------|--------------|
| X^+ | Y^- | X^+ | Y^- | X^+ |
| Y^- | O | Y^- | X^+ | Y^- |
| X^+ | Y^- | X^+ | O | X^+ |
| Y^- | X^+ | Y^- | X^+ | Y^- |

Answer the following questions:

- Is the above defect stoichiometric or non-stoichiometric?
- Write the term used for this type of defect. Give an example of the compound which shows this type of defect.
- How does this defect affect the density of the crystal?

17. Conductivity of 2.5×10^{-4} M methanoic acid is $5.25 \times 10^{-5} \text{ S cm}^{-1}$.

Calculate its molar conductivity and degree of dissociation. Given : $\lambda^0(\text{H}^+) = 349.5 \text{ S cm}^2 \text{ mol}^{-1}$ and $\lambda^0(\text{HCOO}^-) = 50.5 \text{ S cm}^2 \text{ mol}^{-1}$.

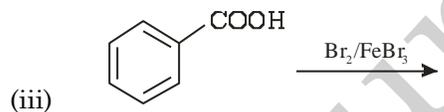
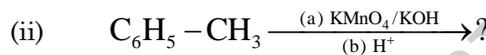
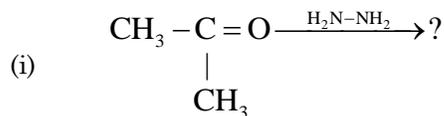
18. Write any three differences between Physisorption and Chemisorption.

19. Give reasons for the following:

- Phenol is more acidic than methanol.
- The C–O–H bond angle in alcohols is slightly less than the tetrahedral angle ($109^\circ 28'$).

(iii) $(\text{CH}_3)_3\text{C–O–CH}_3$ on reaction with HI gives $(\text{CH}_3)_3\text{C–I}$ and $\text{CH}_3\text{–OH}$ as the main products and not $(\text{CH}_3)_3\text{C–OH}$ and $\text{CH}_3\text{–I}$.

20. Predict the products of the following reactions:



21. (a) Account for the following:

- Cu^+ is unstable in an aqueous solution
 - Transition metals form complex compounds.
- (b) Complete the following equation:



22. Write the names and structures of the monomers of the following polymers: 3

- Terylene
- Buna–S
- Neoprene

23. Seeing the growing cases of diabetes and depression among young children, Mr. Chopra, the principal of one reputed school organized a seminar in which he invited parents and principals. They all resolved this issue by strictly banning junk food in schools and introducing healthy snacks and drinks like soup, lassi, milk, etc in school canteens. They also decided to make compulsory half an hour of daily physical activities for the students in the morning assembly. After six months, Mr. Chopra conducted the health survey in most of the schools and discovered a tremendous improvement in the health of the students.

After reading the above passage, answer the following questions:

- What are the values (at least two) displayed by Mr. Chopra?
- As a student, how can you spread awareness about this issue?
- Why should antidepressant drugs not be taken without consulting a doctor?
- Give two examples of artificial sweeteners.

24.

(a) Account for the following:

- (i) Acidic character increases from HF to HI.
 (ii) There is a large difference between the melting and boiling points of oxygen and sulphur.
 (iii) Nitrogen does not form pentahalide.

(b) Draw the structures of the following:

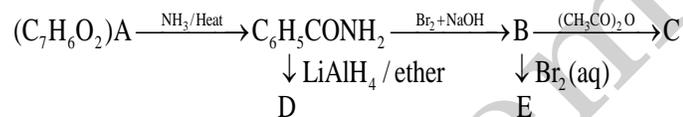
- (i) ClF_3 (ii) XeF_4

OR

- (i) Which allotrope of phosphorus is more reactive and why?
 (ii) How are the supersonic jet aero planes responsible for the depletion of ozone layer?
 (iii) F_2 has lower bond dissociation enthalpy than C_2 . Why?
 (iv) Which noble gas is used in filling balloons for meteorological observations?
 (v) Complete the following equation:



25. An aromatic compound 'A' of molecular formula $\text{C}_7\text{H}_6\text{O}_2$ undergoes a series of reactions as shown below. Write the structures of A, B, C, D and E in the following reactions: 5

**OR**

(a) Write the structures of main products when benzene diazonium chloride reacts with the following reagents:

- (i) $\text{H}_3\text{PO}_2 + \text{H}_2\text{O}$ (ii) CuCN/KCN

(iii) H_2O

(b) Arrange the following in the increasing order of their basic character in an aqueous solution:



(c) Give a simple chemical test to distinguish between the following pair of compounds:



26. For the hydrolysis of methyl acetate in aqueous solution, the following results were obtained:

| t/s | 0 | 10 | 20 |
|---|------|------|-------|
| $[\text{CH}_3\text{COOCH}_3]/\text{mol L}^{-1}$ | 0.10 | 0.05 | 0.025 |

(a) Show that it follows pseudo first order reaction, as the concentration of water remains constant.

(b) Calculate the average rate of reaction between the time interval 10 to 20 seconds (Given : $\log 2 = 0.3010$, $\log 4 = 0.6021$)

OR

(a) For a reaction $\text{A} + \text{B} \longrightarrow \text{P}$, the rate is given by $\text{Rate} = k[\text{A}][\text{B}]^2$

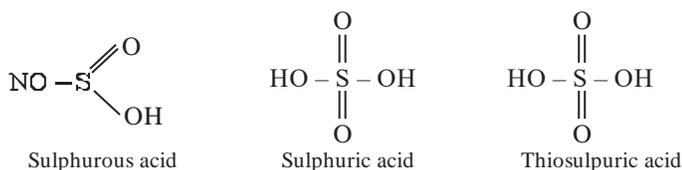
(i) How is the rate of reaction affected if the concentration of B is doubled?

(ii) What is the overall order of reaction if A is present in large excess?

(b) A first order reaction takes 30 minutes for 50% completion. Calculate the time required for 90% completion of this reaction.

SOLUTION

1. Two oxo-acids of Sulphur



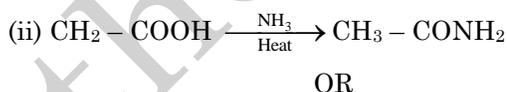
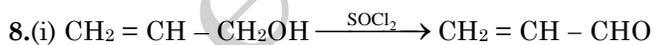
2. 1-Ethoxy-2-Methyl propane

3. River water is a colloidal solution of clay. Sea water contains a number of electrolytes. When river water meets the sea water, the electrolytes present in sea water coagulate the colloidal solution of clay resulting in its deposition with the formation of delta.

4. A tertiary alkyl tends to undergo the $\text{S}_{\text{N}}1$ mechanism because it can form a tertiary carbocation, which is stabilized by the three alkyl groups attached to it. As alkyl group are electron donating, they allow the positive charge in the carbocation to be delocalised by the induction effect. Hence out of the given pair $(\text{CH}_3)_3\text{CBr}$ would undergo $\text{S}_{\text{N}}1$ reaction faster than $\text{CH}_3-\text{CH}_2-\text{Br}$.

5. The number of tetrahedral voids formed is equal to twice the number of atoms of element B and only $\frac{2}{3}$ rd of these are occupied by the atoms of element A. Hence the ratio of the number of atoms of A and B is $2 \times (2/3) : 1$ or $4 : 3$ and the formula of the compound is A_4B_3 .

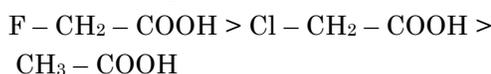
7. (i) Pentaminochlorido – Cobalt (III)
(ii) $\text{K}_2[\text{Ni}(\text{Cl})_4]$



(i) Increasing order:



(ii) Increasing order:



9. (i) On mixing Liquid X and Liquid Y, volume of the resulting solution decreases. Negative deviation shown by the resulting solution in which

$$F_{\text{X-Y}} > F_{\text{X-X}} \text{ and } F_{\text{Y-Y}}$$

Due to this there is decrease in the escaping tendency of X or Y molecules from the surface of solution.

Consequently, the vapour pressure of the solution will be lower.

(ii) When we place the blood cell in water (hypotonic solution), they would swell due to osmosis and may even burst.

10. Deposit = 1.27 gm of copper
Current = 2A
 $\text{Cu} = 63.5 \text{ gm mol}^{-1}$
 $1 \text{ F} = 96500 \text{ C mol}^{-1}$
The reaction occurring at cathode is



For depositing one mole of Cu atoms the electrons required = 2 mol

Charge on 2 mol of electron = $2 \times 96500 = 193000$

Deposition of 1.27 gm of Cu requires

$$\frac{2 \times 96500}{63.5} \times 1.27 = 2 \times 1930 \text{ C} = 3860$$

Calculation of time: Current Strength = 2 A

No. of Coulombs = $2 \times t\text{c}$

$$t = \frac{3860\text{C}}{2} = 1930 \text{ Sec.}$$

11. Let the molar mass of the solute = M_{B}

$$\text{Moles of water} = \frac{200}{8} = 11.1$$

$$\text{Moles of solute} = \frac{10}{M_{\text{B}}}$$

Applying Raoult's Law,

$$\frac{P_0 - P_s}{P} = \frac{W_{\text{B}}}{M_{\text{B}}} \times \frac{M_{\text{A}}}{W_{\text{A}}}$$

$$\frac{32 - 31.84}{32} = \frac{10}{M_{\text{B}}} \times \frac{18}{200}$$

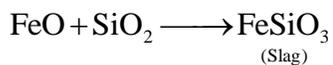
$$\frac{0.16}{32} = \frac{1}{M_{\text{B}}} \times \frac{9}{10}$$

$$M_{\text{B}} = \frac{9 \times 32}{10 \times 0.16} = 180 \text{ gm/mole}$$

12. (i) Zone refining to obtain silicon of high purity. Zone melting is a group of similar methods of purifying crystals, in which a narrow region of a crystal is molten, and this molten zone is moved along the crystal.

(ii) Sometimes, it is possible to separate two sulphide ores by adjusting proportion of oil to water or by using "depressants". It selectively prevents ZnS from coming to the froth but allows PbS to come with the froth.

(iii) The sulphide ores of copper are heated in reverberatory furnace. If the ore contains iron, it is mixed with silica before heating. Iron oxide "slags off" as iron silicate and copper is produced in the form of copper matte which contains Cu_2S and FeS .



It is utilized for manufacturing H_2SO_4

13.

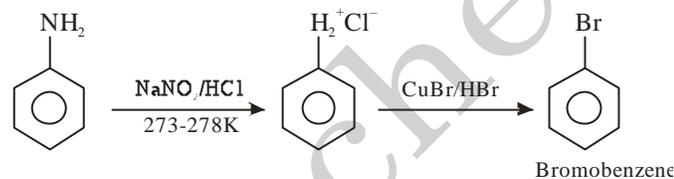
(i) Starch is a polysaccharide.

(iii) Pernicious anemia and scurvy (bleeding gums).

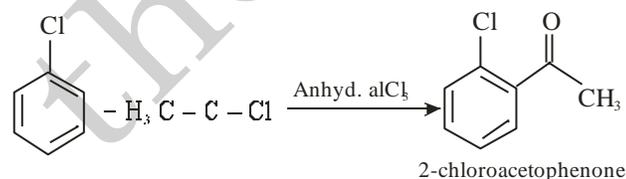
14. (i) Solvate Isomerism

(iii) $[\text{CoF}_6]^{3-}$ is an outer orbital or high spin complex involving sp^3d^2 hybridization.

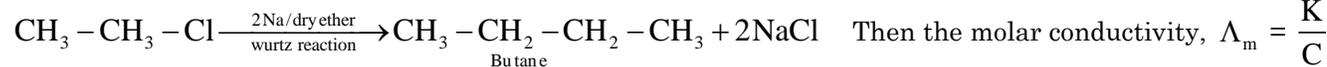
15. (i) Aniline to bromobenzene:



(ii) Chlorobenzene to 2-chloroacetophenone

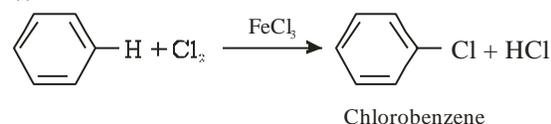


(iii) Chloroethane to butane:



OR

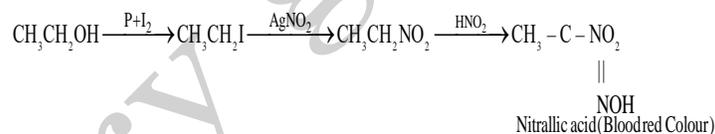
(i) Chlorobenzene is treated with $\text{Cl}_2/\text{FeCl}_3$.



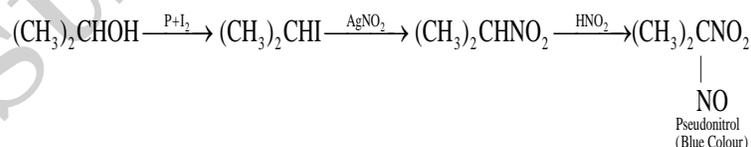
In the presence of an iron catalyst, chlorine reacts rapidly with benzene to give chlorobenzene and HCl . FeCl_3 , catalyst substitutes a halogen for an H.

(ii) Ethyl chloride is treated with AgNO_2 Victor-Mayer Method : On treatment with AgNO_2 yields nitroalkanes on treating the latter with aqueous NaNO_2 acidified with HCl and then alkaline with NaOH produces different colouration.

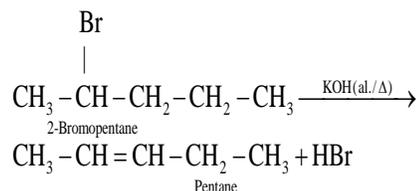
(i) alcohol



(ii) alcohol



(iii) 2-bromopentane is treated with alcoholic KOH



16. (i) It is stoichiometric defect.

(ii) This term also known as point defect. e.g. Frenkel defect. It is also called dislocation defect. It does not change the density of the solid. The size of the ions, have large difference due to small size of Zn^{2+} and Ag^+ ions.

(iii) Like simple vacancy defect, Schottky defect also decreases the density of the substance. Number of such defects in ionic solids is quite significant.

17. Given, $K = 5.25 \times 10^{-5} \text{ S cm}^{-1}$

$$C = 2.5 \times 10^{-4} \text{ ML}^{-1}$$

$$\begin{aligned} \text{Then the molar conductivity, } \Lambda_m &= \frac{K}{C} \\ &= \frac{5.25 \times 10^{-5} \text{ Scm}^{-1}}{2.5 \times 10^{-4} \text{ ML}^{-1}} \times \frac{1000 \text{ cm}^3}{\text{L}} = 210 \text{ cm}^2 \text{ M}^{-1} \end{aligned}$$

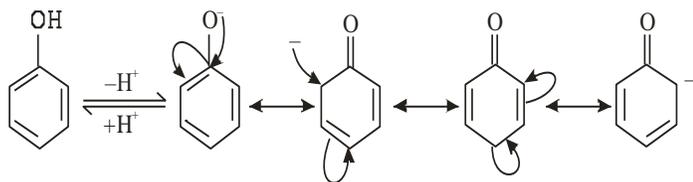
$$\begin{aligned}\Lambda_m^\circ(\text{HCOOH}) &= \lambda^\circ(\text{H}^+) + \lambda^\circ(\text{HCOO}^-) \\ &= 349.5 \text{ S cm}^2 \text{ mol}^{-1} + 50.5 \text{ S cm}^2 \text{ mol}^{-1} \\ &= 400 \text{ S cm}^2 \text{ mol}^{-1}\end{aligned}$$

$$\Lambda_m = 5.25 \times 10^{-5} \text{ cm}^{-1}$$

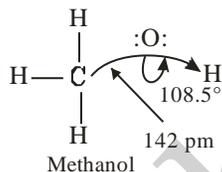
Now,

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{50.5 \text{ S cm}^2 \text{ M}^{-1}}{349.5 \text{ S cm}^2 \text{ M}^{-1}} = 0.14$$

19. (i) When phenol loses the phenolate ion is stabilized due to the resonance effect. The energy of the dissociated form is lower and so the phenol has more chance to be in the solution dissociated with the phenolate ion. Aliphatic alcohols are not stabilized by resonance so they are not very prone to be dissociated.

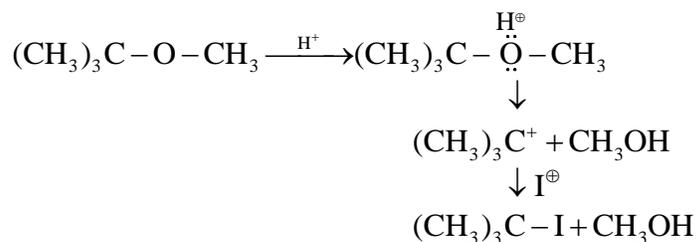


(ii) The C-O-H bond angle in alcohol is slightly less than the tetrahedral angle ($109^\circ 28'$). It is due to the repulsion between the unshared electron pairs of oxygen.

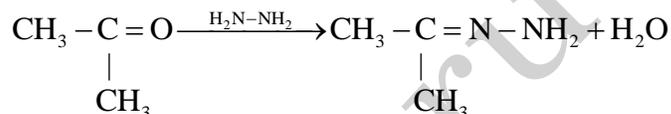


Slightly greater than the tetrahedral angle ($109^\circ 28'$) due to the repulsive C-O bond length (141 pm) in ethers is almost the same as in alcohols (142 pm) in methanol.

(iii) Usually, iodide being a big nucleophile, attacks on the group with low steric hindrance and the reaction proceeds by $\text{S}_{\text{N}}2$ mechanism. However, in this case, methanol, on leaving generates a tertiary carbocation, which is more stable. Hence, this reaction proceeds by $\text{S}_{\text{N}}1$ mechanism and therefore, we get $(\text{CH}_3)_3\text{C-I}$ and $\text{CH}_3\text{-CH}$ as the major products.



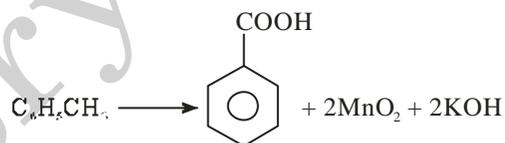
20. (i)



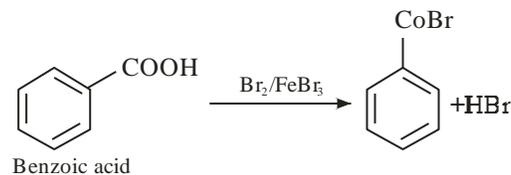
(ii)



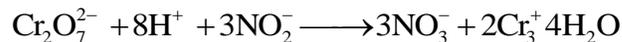
OR



(iii)



21.



23. (i) The value displayed by Mr. Chopra are:

Care: He showed concern for the health of the students.

Selfless service: We conducted seminar and health survey in most of the schools.

(ii) Awareness regarding diabetes and depression can be spread among students by seminars, health camps, debates, pamphlets, workshops by doctors, etc. to highlight the need to follow healthy eating habits and importance of physical activity in day to day life of students.

(iii) Antidepressant drugs are those class of organic compounds that are neurologically active drugs. These drugs reduce the symptoms of major depressive disorders and other conditions, including anxiety disorders, obsessive compulsive disorder, eating disorder, chronic pain, neuropathic pain and

sleep disorder by correcting chemical imbalances of neurotransmitters in the brain, e.g., Iproniazid, phenelzine.

(iv) Artificial sweetening agents such as aspartame can be used in preparation of sweets for a diabetic patient, e.g., saccharin and aspartame.

24. (ii) Oxygen and Sulphur are non-metals, selenium and tellurium metalloids, whereas polonium is a metal.

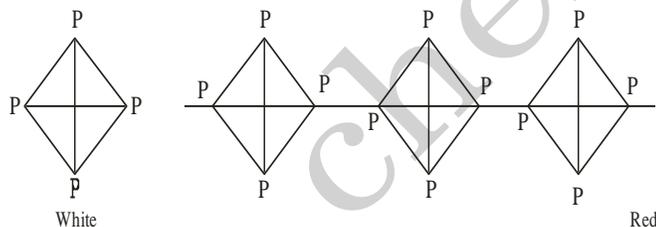
The melting and boiling point increase with an increase in atomic number. The large difference between the melting and boiling point of oxygen and sulphur may be basis of their atomicity, oxygen exists as diatomic molecule whereas sulphur exists as polyatomic molecule (S₈).

| Name of the elements | Boiling point degree Celsius | Melting point degree Celsius |
|----------------------|------------------------------|------------------------------|
| Oxygen | 183 | -218.4 |
| Sulphur | -10 | -75.5 |

(iii) Nitrogen does not have d-orbitals to expand its covalence beyond four. That is why it does not form pentahalide.

OR

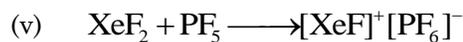
(i) **Allotropic form** : White, red, α-black & β-black.



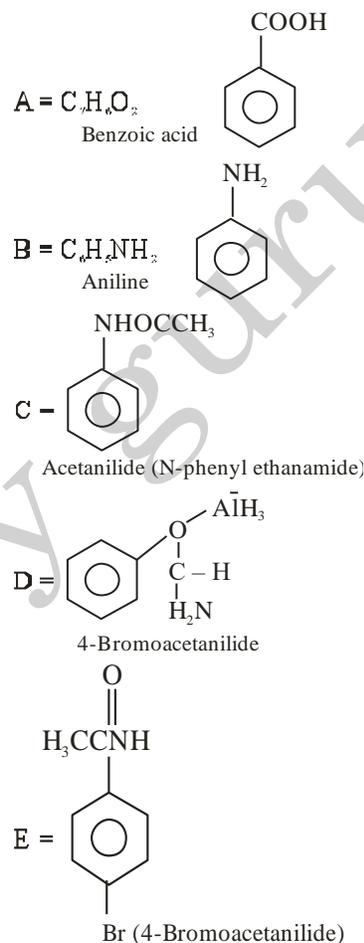
(ii) When a high-flying spy plane dore through the exhaust of a concorde supersonic jet flying tourists around the world. This transition area between the turbulent, cloudy lower atmosphere and near-space contains the ozone layer and particles, natural and artificial, on ozone depletion and global warming. The plane's exhaust injects additional nitrogen oxide into the stratosphere.

(iv) Helium is a non-flammable and light gas. Hence, it is used in filling balloons for meteorological observations. It is also used in gas-cooled nuclear reactors. Liquid helium finds use as cryogenic agent

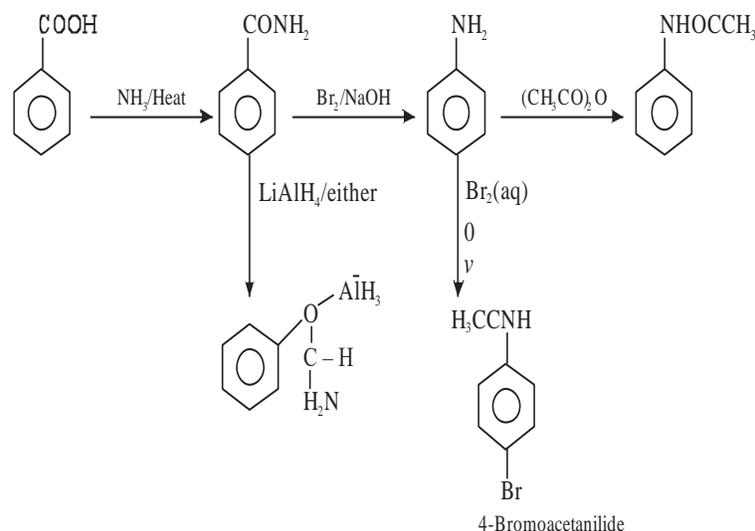
for carrying out various experiments at low temperature.



25.

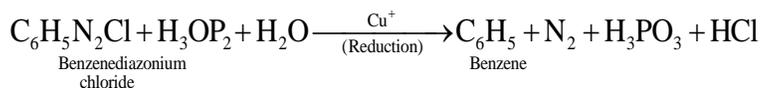


Reactions:

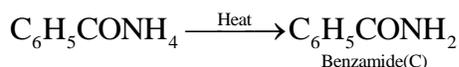
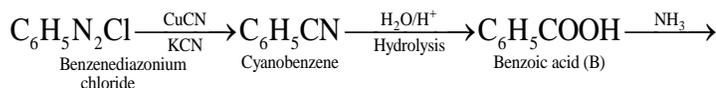


OR

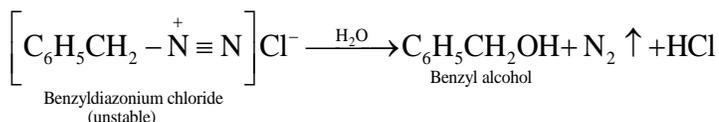
(a) (i)



(ii)



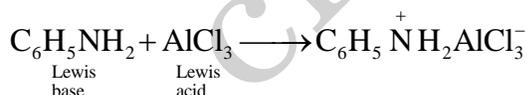
(iii)



(b) In gaseous phase, basic character of amines increases with increase in number of electron releasing group, due to +I effect, so trend of basic character is $3^\circ > 2^\circ > 1^\circ$.

But in aqueous phase, solvation of ammonium cation occurs by water molecules, greater the size of ion, lesser will be the solvation, and lesser will be the stability of ion, so on combining +I effect and solvation effect, in aqueous phase trend changes to $2^\circ > 3^\circ > 1^\circ$.

(c) Aniline being a Lewis base, reacts with Lewis acid AlCl_3 to form a salt.



As a result, N of aniline acquires positive charge and hence it acts as a strong deactivation group for electrophilic substitution reaction. Consequently aniline does not undergo Friedel Craft's reaction.

26. $K = \frac{2.303}{t} \log \frac{[A_0]}{[A]}$ in which $[A_0] = 0.10$

$$T = 10 \text{ S}, K = \frac{2.303}{10} \log \frac{[0.10]}{[0.05]} = \frac{2.303}{10} \log(2)$$

$$= \frac{2.30}{10} \times 0.3010 = 0.06932 = 6.932 \times 10^{-2}$$

$$t = 20 \text{ S}, K' = \frac{2.303}{20} \log \frac{[0.05]}{[0.025]}$$

$$= \frac{2.303}{20} \log(2) = \frac{2.303}{20} \times 0.3010$$

$$= 0.03466 = 3.466 \times 10^{-2}$$

(b) Average rate during the interval 10–20 seconds

$$\frac{C_2 - C_1}{t_2 - t_1} = \frac{(0.025 - 0.05)}{20 - 10}$$

$$= \frac{0.025}{10} = 0.0025 = 2.5 \times 10^{-3} \text{ mol L}^{-1} \text{ S}^{-1}$$

OR

(a) (i) $\text{A} + \text{B} \longrightarrow \text{P}$ Rate = $k [\text{A}] [\text{B}]^2$

Differential rate equation of

reaction is $\frac{dn}{dt} = k[\text{A}]^1[\text{B}]^2 = k[\text{A}][\text{B}]^2$

When concentration of B is doubled, it means concentration of B becomes $[2 \times \text{B}]$

\therefore New rate of reaction,

$$\frac{dn}{dt} = k[\text{A}][2\text{B}]^2 = 4k[\text{A}][\text{B}]^2 = 4 \left[\frac{dn}{dt} \right]$$

i.e., rate of reaction will become 4 times.

(ii) A useful protocol for determining the order of reaction with respect to a particular component is to measure the concentration dependence of rate when all other reactants are in great excess.

Under these circumstances, their concentrations will not vary significantly during the reaction, and the rate law revealed by experiments will give the order of reaction with respect to the tested component.

$$v = k[\text{A}]_{\text{excess}}^a [\text{B}]^b$$

$$v = k' [\text{B}]^b$$

$$k = k[\text{B}]_{\text{excess}}^a$$