

PRE-FINAL II COTTON University II

Chemistry - 2024

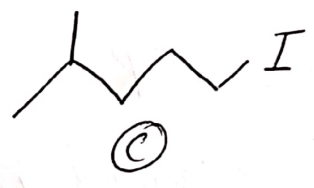
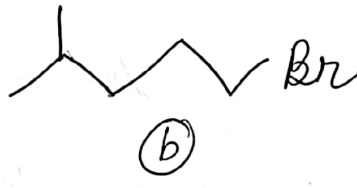
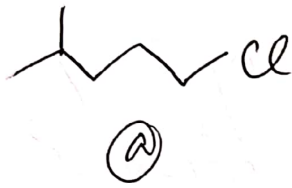
Answers prepared by Brojesh Baisheyar, Nagore.

Q1. Name the metal ions present in vitamin B12 and chlorophyll

Ans. : As vitamin B12 consists of metal ion cobalt that's why it is also known as cobalamin. chlorophyll is packed with vitamin B12, making it an excellent natural energy source. Extra : Copper present in hemocyanin, magnesium is a component of chlorophyll, zinc is present in carbonic anhydrase.

Q2. Among the following alkyl halides, which one will undergo S₂ reaction faster than the other two?

Ans. :



(c) will react faster in S_N2

Q3. The nature of the alpha carbon of an alkyl halide is nucleophilic or electrophilic (find and write the correct option) ?

Ans. : It is electrophilic in nature during Alkyl Halide Reactions. The carbon gains a partial positive charge and the Halide atom gains a partial negative charge. The positively charged carbon in this case would be the electrophile.

Q4. Which of the following ethers cannot be prepared by the Williamson's method ?



Ans. : Di-tert-butyl ether

Ethers can be prepared by Williamson synthesis in which an alkyl halide is reacted with sodium alkoxide. Di-tert-butyl ether can't be prepared by this method. Because it prefers elimination rxⁿ rather than substitution.

Q5. Give one example of a hexadentate Ligand. Draw its structure ?

EDTA Ethylenediamine tetraacetic acid



Q6 / OR. Find the molarity of a solution of glucose in water containing 0.1 mole glucose in 200 mL of the solution.

$$\begin{aligned} \text{Molarity} &= \frac{\text{mole of solute}}{\text{vol. of sol}^n \text{ in L}} \\ &= \frac{0.1}{200/1000} \\ &= \frac{100}{200} \\ &= 0.5 \end{aligned}$$

Q7. Write an equation showing the variation of the molar conductivity Λ^m a strong electrolyte solution with its molar concentration c , noting the two constants used there.

Ans. : Variation of molar conductivity with concentration of strong electrolyte is given by Debye Huckel-Onsager equation expressed as:

$$\Lambda^m = \Lambda^\infty - b\sqrt{c}$$

Q8. For a first-order reaction of the type $R \rightarrow P$, what is the simple mathematical relation between its half-life and its rate constant k ?

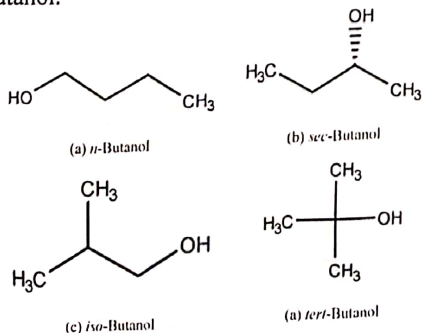
Ans. : The half-life of a first-order reaction is a constant that is related to the rate constant for the reaction: $t_{1/2} = 0.693/k$.

Q9. Name the lanthanide elements in correct order and give their chemical symbols.

Ans. : The 15 elements, together with their chemical symbols, are lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), and lutetium (Lu).

Q10. What are the structural isomers of butanol? Which one among them will undergo fastest dehydration with H_2SO_4 ?

Ans. : There are four isomers of butanol with the same chemical formula, but different structural arrangement. Isomers of butanol are n-butanol, isobutanol, tert-butanol, and sec-butanol.



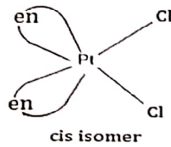
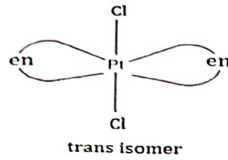
Acid catalysed dehydration of *t*-butanol is faster than that of *n*-butanol because: Therefore the reactivity of alcohol is governed by the stability of carbocation that follows the order as

Tertiary > secondary > primary

Q11. Write IUPAC name of the complex $[Pt(en)_2Cl_2]$. Draw structures of geometrical isomers for this complex.

Ans. : The name of this complex is Dichloridobis(ethane-1,2-diammine)platinum(II). This complex is named by IUPAC nomenclature as follows: For the compound, the platinum Pt has oxidation number as +2. So Platinum(II) is the base name.

Geometrical isomers are

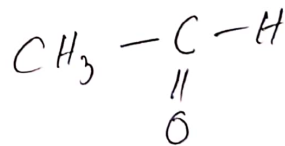
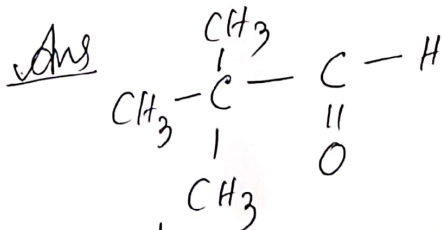
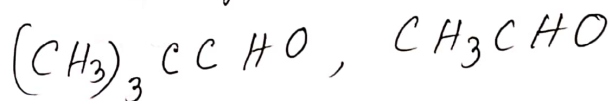


Pattern classes
98690 89106

Q12 (i). Between propanal and propanone which one is more reactive towards nucleophilic addition reaction and why?

propanal is more reactive than propanone. due to presence of alkyl groups on both sides of the carbonyl carbon, propanone is sterically more hindered than propanal, making it less reactive to nucleophilic attack.

Q12 OR. which of the following compounds would undergo Cannizzaro reaction?



↓
This will undergo Cannizzaro rxn as it don't contain α -H

Basicity = pyrrole < aniline < pyridine / Benzyl amine

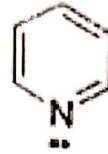
15. (i) Which among the following heterocyclic amines will have lower pK_b than the other? 1

pyridine < pyrrole (K_b)
 pyridine < pyrrole (pK_b)

lone pair of an N atom is already involved in the aromatic character. K is delocalised.

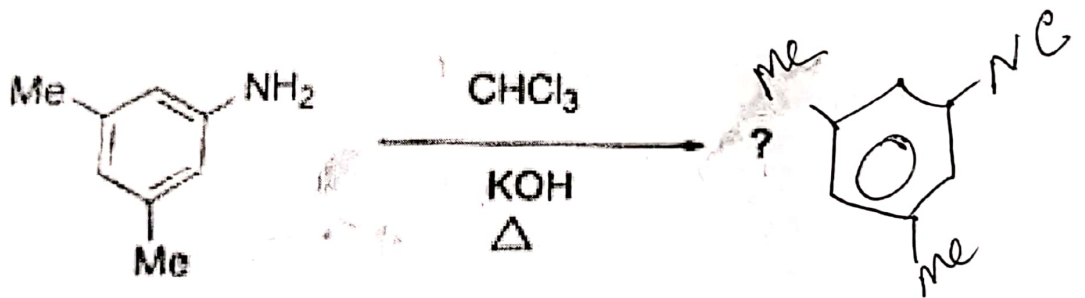


Pyrrole

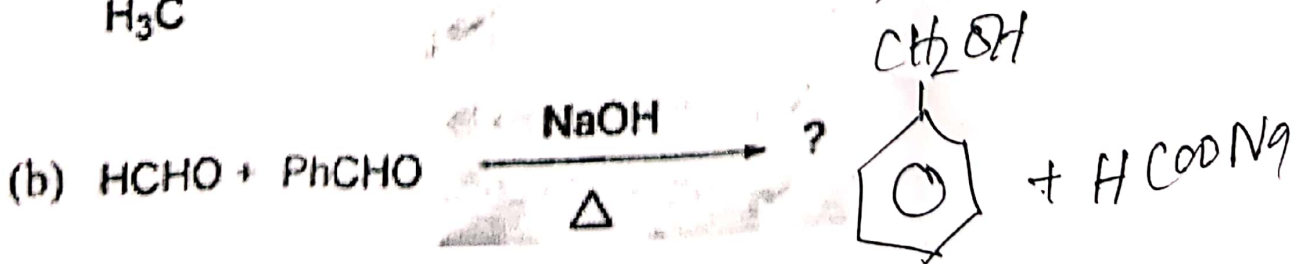
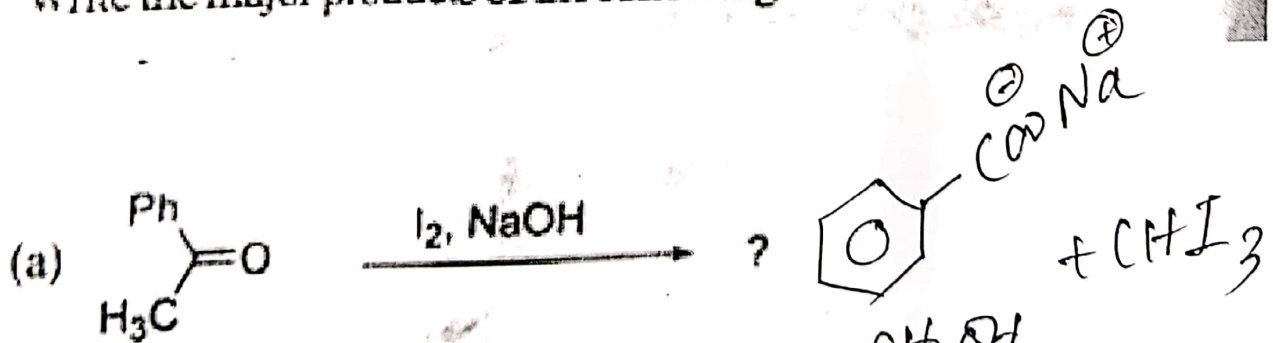


Pyridine

(ii) Write the product of the following reaction. 1



16. Write the major products of the following reactions. 1+1=2



17. State the Kohlrausch law of independent migration of ions. According to this law, what will be the value of the limiting molar conductivity Λ_m° of $Al_2(SO_4)_3$ solutions, given that the limiting molar ionic conductivities $\lambda_{Al^{3+}}^\circ$ and $\lambda_{SO_4^{2-}}^\circ$ of the Al^{3+} and the SO_4^{2-} ions, at the same temperature, are $215 \text{ S cm}^2 \text{ mol}^{-1}$ and $110 \text{ S cm}^2 \text{ mol}^{-1}$ respectively? $1+1=2$



$$\begin{aligned} \Lambda_{Al_2(SO_4)_3}^\circ &\Rightarrow 2 \cdot \lambda_{Al^{3+}}^\circ + 3 \lambda_{SO_4^{2-}}^\circ \\ &= 2 \times (215) + 3(110) \text{ S cm}^2 \text{ mol}^{-1} \\ &= 960 \text{ S cm}^2 \text{ mol}^{-1} \end{aligned}$$

18. Starting from the differential rate equation $-d[R]/dt = k$ for the zeroth order reaction, obtain its integrated rate expression $[R] = [R]_0 - kt$. 2

$$\begin{aligned} \text{Rate} = -\frac{d[R]}{dt} = k & \Rightarrow [R]_0^R = -k \times t \\ \Rightarrow d[R] = -k dt & \Rightarrow [R] - [R]_0 = -k \times t \\ \int_{[R]_0}^R d[R] = -k \int_0^t dt & \Rightarrow [R] = [R]_0 - kt \end{aligned}$$

19. Give reasons for the following: $1+1+1=3$

তলত দিয়াবোৰৰ বাবে কাৰণ দৰ্শোৱা :

- (i) Transition metals show variable oxidation states.

Already answered in previous lecture.

- (ii) Transition elements and their compounds acts as a catalyst.

They have $(n-1)d$ orbitals empty that are closer to the outermost ns orbital in energy levels. They always accommodate more electrons in $(n-1)d$ orbitals.

Because large value of 2nd I. E. of Copper is compensated by much more negative hydration energy of Cu^{2+} (aq).

(iii) Cu^+ ion is not stable in aqueous solution.

জনীয় প্রদত্ত Cu^+ আয়ন স্থিতি নহয়।

20. An aqueous solution containing 12.0 g of an involatile molecular solid dissolved in 100 g of water shows a freezing point depression of 3.72 K. Given that the freezing point depression constant for water is $1.86 \text{ K kg mol}^{-1}$, determine the molar mass of the solid solute. 3

$$\Delta T_f = K_f \times \text{molarity}$$

$$\Rightarrow 3.72 = 1.86 \times \frac{12/m}{100/1000}$$

$$\Rightarrow \frac{3.72}{1.86} = \frac{12 \times 10}{m} \Rightarrow M = 60 \text{ g mol}^{-1}$$

Or/অথবা

A 500 mL solution containing 1.5 g of acetic acid (CH_3COOH) dissolved in benzene showed an osmotic pressure of 0.624 bar at 300 K temperature. Calculate the abnormal molar mass of the solute and hence estimate the vant Hoff factor for this solution. [Given that $R = 0.08314 \text{ bar L mol}^{-1} \text{ K}^{-1}$.] 3

$$\pi = CRT$$

$$= \frac{m}{\text{Volume}} RT$$

$$\Rightarrow \frac{1.5/60}{500/1000} RT$$

$$= 1.245$$

$$i = \frac{\text{Observed colligative Property}}{\text{Theoretical colligative Property}}$$

$$i = \frac{0.624}{1.245}$$

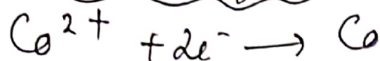
$$= 0.501$$

$$i = \frac{\text{Normal Molar Mass}}{\text{Abnormal molar mass}}$$

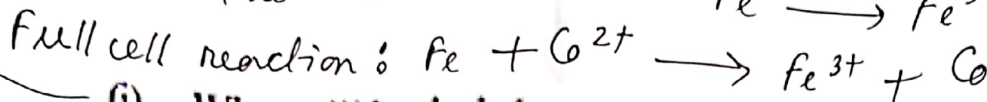
$$\Rightarrow \text{Abnormal molar mass} = \frac{60}{0.501} = 119.760 \text{ g mol}^{-1}$$

21. The standard electrode potentials of the $\text{Co}^{2+}(\text{aq})|\text{Co}(\text{s})$ and the $\text{Fe}^{2+}(\text{aq})|\text{Fe}(\text{s})$ electrodes are, respectively, -0.28 V and -0.44 V .

Cathode half cell rxn



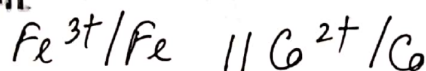
Anode half cell rxn



(i) What will be the balanced chemical equation for the spontaneous redox reaction involving these two ions and two metals?

(ii) For this redox reaction occurring within a Galvanic cell, what will be the standard cell emf E_{cell}° and the number of electrons n_{cell} for the cell?

(iii) Calculate the standard Gibbs free energy for this reaction.



$$1+1+1=3$$

(ii) $E_{\text{cell}}^{\circ} = -0.28 - (-0.44) = 0.16 \text{ V}$

No. of electrons involved = 6

(iii) $\Delta G = -n E^{\circ} F$

$$= -6 \times (0.16) \times 96500$$

$$= -92640 \text{ C}$$

22. Sketch a possible plot for $\log_{10} k$ versus $(1/T)$ for a chemical reaction with the rate constant k at the Kelvin temperature T . What is the slope (gradient) of this plot in terms of the activation energy E_a ? If for a reaction this slope was found to be 2000 K, calculate the activation energy. $1+1+1=3$

23. Using valence bond theory, write the hybridization involved, geometry and magnetic behavior of $[\text{CoF}_6]^{3-}$ and $[\text{Co}(\text{NH}_3)_6]^{3+}$.

(NH_3) is a strong field ligand

→ d^2sp^3
 → octahedral complex
 → diamagnetic

→ sp^3d^2
 → octahedral
 → 4-unpaired electrons
 ↓
 paramagnetic

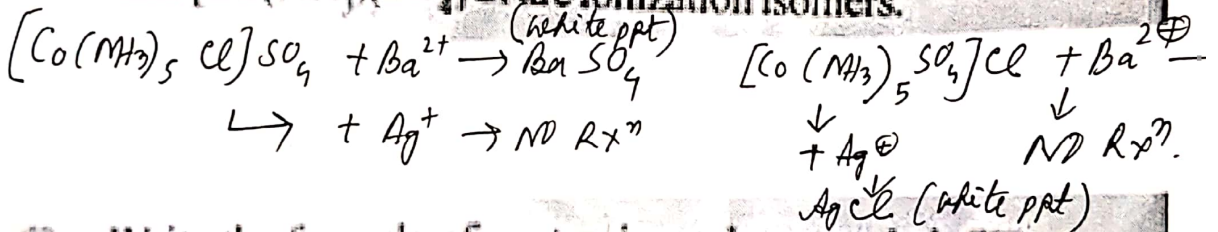
Or/অথবা

Answer the following :

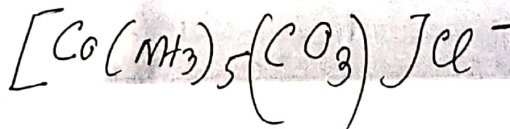
1+1+1=3

তলত দিয়াবোৰৰ উত্তৰ দিয়া :

(i) Give chemical tests to show that $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Cl}$ are ionization isomers.



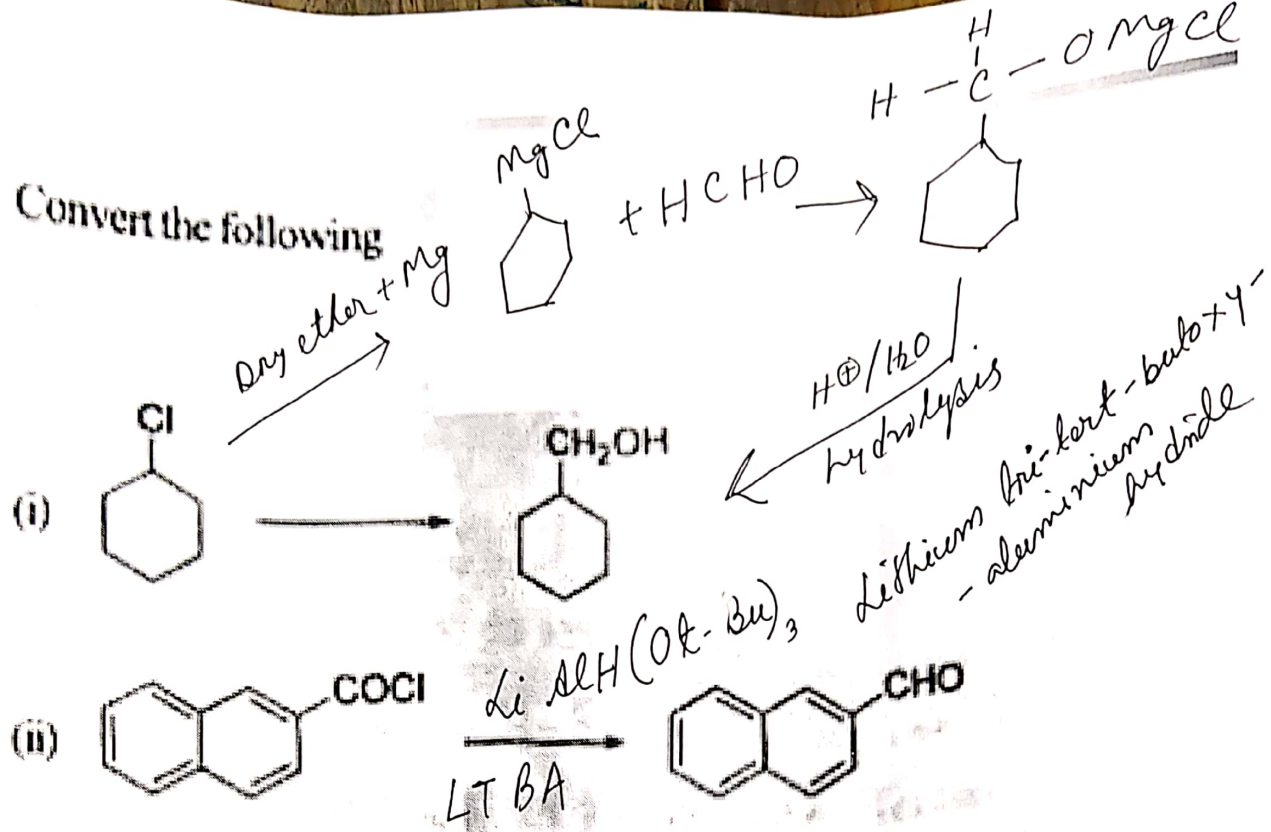
(ii) Write the formula of pentamminecarbonatocobalt (III) chloride.



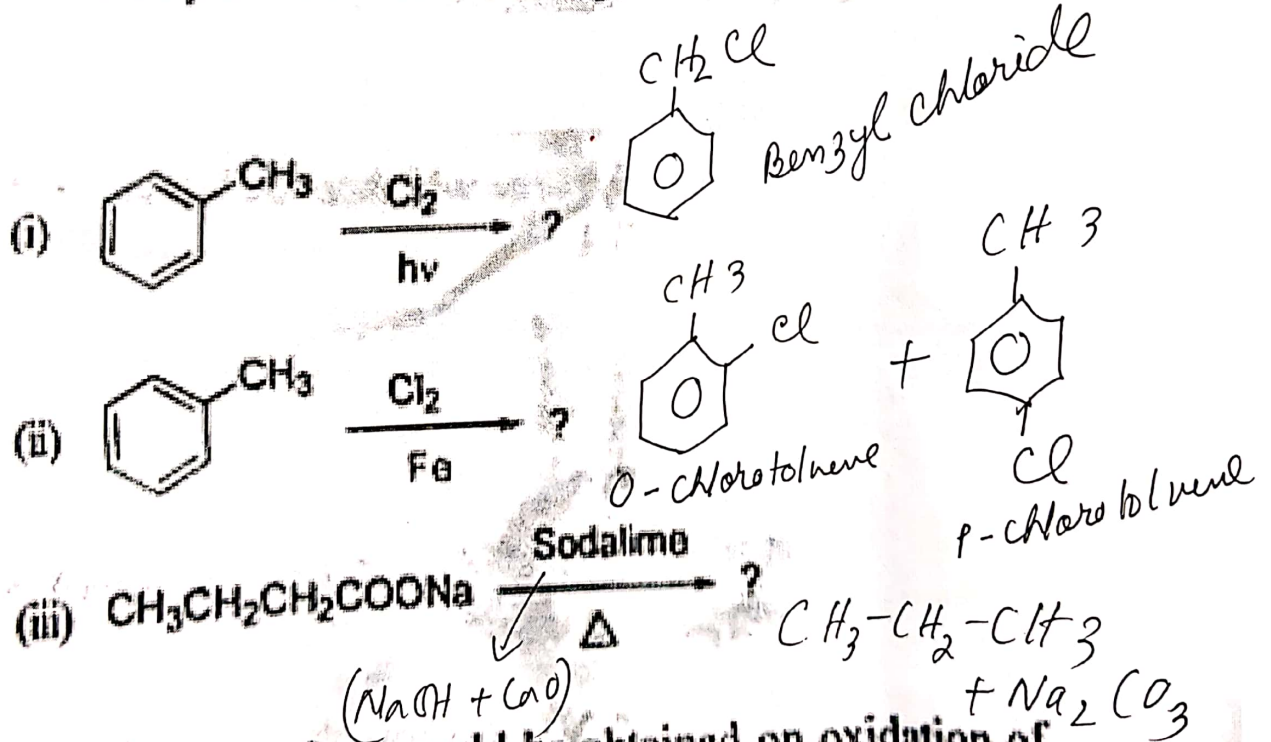
(iii) Name the type of isomerism exhibited by ambidentate ligands. Give one example of ambidentate ligand.

Linkage isomerism, NO_2^- & ONO^-
 NO_2^- , CNS , CN etc.

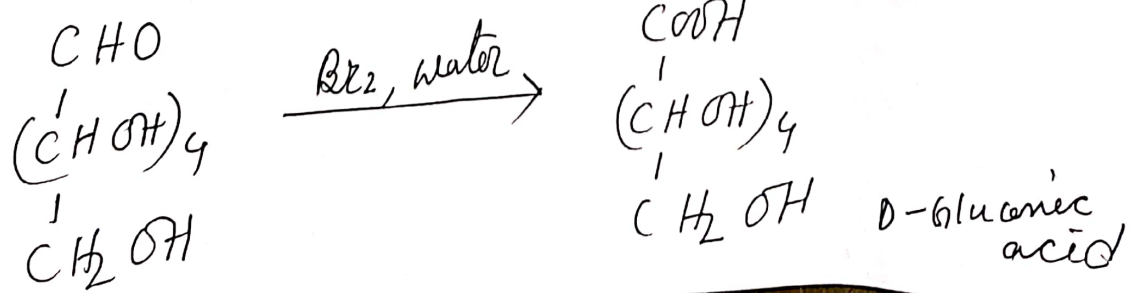
24. Convert the following



25. Write the products of the following reactions. 1+1+1=3



26. (a) What product would be obtained on oxidation of glucose with bromine-water?



(b) What is 'animal starch'?

Glycogen (Polymerised glucose is stored in mammals)

(c) Deficiency of a vitamin causes bone deformation but exposure to sunlight helps to get relief. Name the vitamin.

Vitamin D largely comes from exposing the skin to sunlight.

27. (a) Why water soluble vitamins require regular supply through diet?

They are readily excreted in urine and can't be stored in our bodies.

(b) Name the hormone which tends to elevate blood glucose level.

Glucagon increases blood sugar levels, whereas insulin decreases blood sugar level.

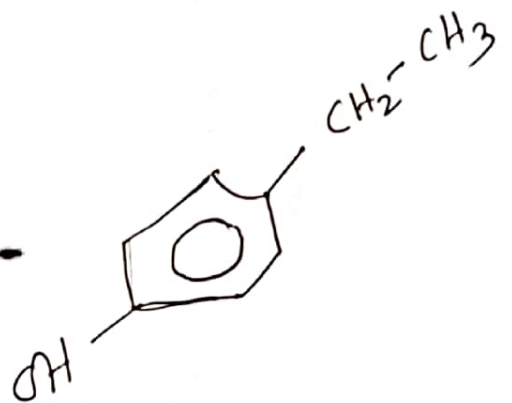
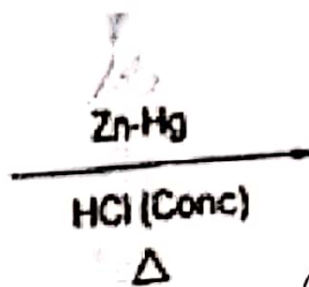
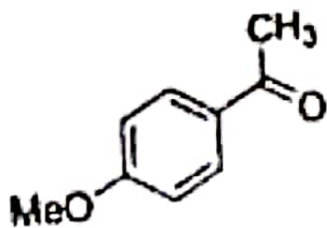
(c) Which RNA carries genetic information from DNA for protein synthesis?

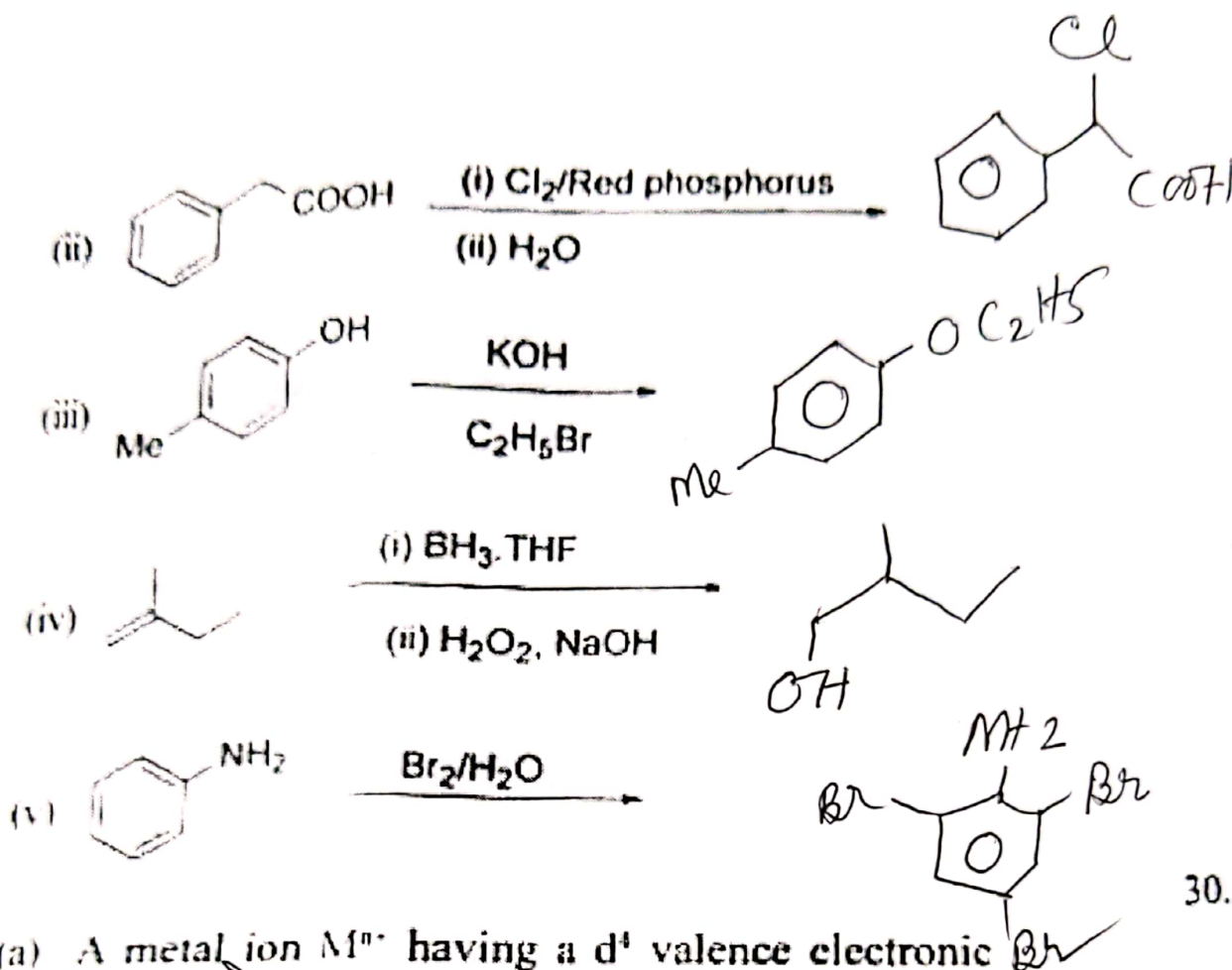
messenger RNA or (mRNA)

Complete the following reactions:

Clemmensen
rxn

(i)





29 (a) A metal ion M^{n+} having a d^4 valence electronic configuration combines with three didentate ligands to form a coordination compound. Assuming $\Delta_0 > P$.

(i) Draw the diagram showing d-orbital splitting during the complex formation.

Already answered in previous lectures