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# CBSE

# SAMPLE PAPERS

For **2023** Examination

# CHEMISTRY

## With Answers

Based on Easy, Average & Difficult Level of Questions

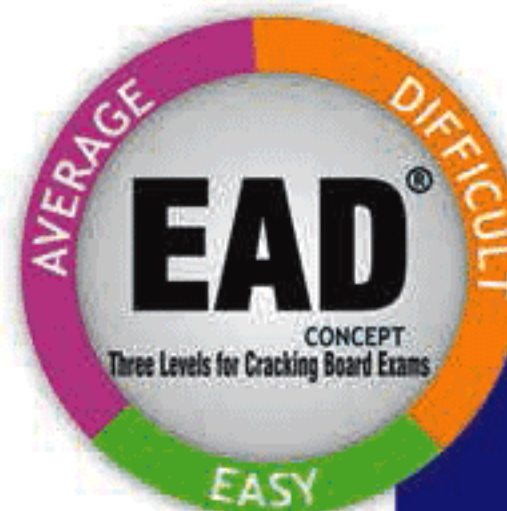
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**PAPERS**

**Chemistry**

(With Answers)

As per the CBSE Circular released on September 16, 2022

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*Pathfinder Global School*

*Haryana*



**For Class**

**12**

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# Chemistry

CLASS 12

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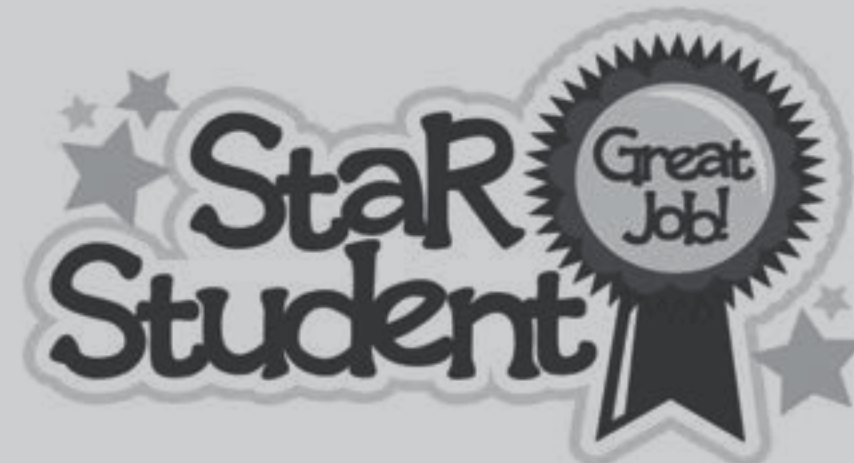
## SELF-SIGNED CERTIFICATE

*I, \_\_\_\_\_, hereby confirm that I will try to do my best in Board Examination without taking any undue stress.*

*I will live the life of my dreams according to my vision and purpose instead of the expectations and opinion of others.*

*"I expect the best, aspire for the best, and do my best."*

\_\_\_\_\_  
*(Signature)*



*All the best!!*

*All the best!!*

*All the best!!*

# A CREATIVE FUTURE OF YOUR OWN MAKING



केन्द्रीय माध्यमिक शिक्षा बोर्ड  
CENTRAL BOARD OF SECONDARY EDUCATION



11<sup>th</sup> February, 2020

Dear children,

I have a colleague who recounts the story of his lawyer daughter with much pride today. A few years back his daughter was taking the board exams. Like many other parents these days, he had several sleepless nights and stress-torn days, for he would sit with her and make her revise. When her results came out, my colleague was disappointed, because according to him she had performed averagely. When his daughter showed up bright-eyed at his office later that day with her report card, and saw her father's crestfallen face, here is what she had to say: "Don't feel bad Papa. You did your best"! I can't but help appreciate the gumption and spirit of this rare kid, for it reflects a true understanding of how board exams do not and cannot rule your life!

Schooling is not only about board exams. Now that I look back, I often wonder what I really took home from my school studies. I remember the picnics, the yearly fairs, sports and annual days, the friends and the fun, the sharing and the caring, the laughter and the tears. But in studies, I remember vague things, like in History there were loads of dates which I had memorized then, but really cannot recall today. I would time and again tell my friends, "Do anything in life, but refrain from creating history. Kids of the next generation will never forgive you". In geography, I would often curse the Americas for having a completely different set of flora and fauna as compared to Africa. Why could the world not be uniformly simple? With Mathematics, I was like an Alice in Wonderland. In Physics I understood its applications very well, but practiced inertia or "staying-a-trest-unless-force-is-applied". Chemistry for me was just trillions of different combinations of the English alphabet and the Arabic numerals. But Biology was a subject that aroused my curiosity. I loved the subject so much that just for fun I would write autobiographies of a red blood corpuscle or a mitochondrion. I found my niche there. It was in the Art room and in extra-curricular activities that I tended to outshine more than in academics. I loved the fact that I could create anything on a blank canvas with a bunch of colours at hand, or tax my mind for the Just A Minute debates or a game of dumb charades, or remember the longest dialogues while acting on stage. I think these are what made me outgoing enough to try out adventurous activities, such as a life in bureaucracy! What I don't remember however, is what questions were asked in my board exams or how did they go.

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I am sharing all this with you because I want you to know that we adults do not get to where we are today by being good at every subject and every activity in our school days. Schooling is surely about exposure to various subjects, but it is much more about learning to become a life-long learner and about acquiring values and skills.

You are 21<sup>st</sup> century kids! Your future employers may not always bother too much about the marks you get in school. They will want to know instead, whether you are capable of working hard or are a creative person. Some may want to check out your critical thinking and problem-solving abilities. Others may focus on good communication or collaboration skills. But all will want to know if you are honest and principled in your dealings, are gender sensitive and a good citizen, are inclusive and can be a part of a team. Known or unknown to you, I am certain that you have already imbibed these and many more skills and values, and therefore, as far as your future is concerned, you have already passed in flying colours!

You have also scaled many peaks in your life; from crawling you learnt to walk, from gibberish you learnt to talk, you learnt to make friends, do teamwork, read, write, play, paint, dance, sing, search internet, cook, do gardening, respect your elders, imbibe your culture, and the list goes on and on. Each of these have helped hone your personality to become the incomparable gem that you are today. Exams are just one among the thousands of things in that list; really, they are not as big a deal as they are made out to be. They are just milestones in your journey towards discovering the real potential and uniqueness in you. And like every other thing in that list that you have learnt to do, it all begins with one belief: I can do it!

A creative future of your own making, bedecked with your values and competencies, awaits you just around the corner. Therefore, armed with the knowledge of all your inimitable capabilities, now go forth and attack your worries, lay them to rest, work hard and do your best.

Kiddos, you've totally got this!

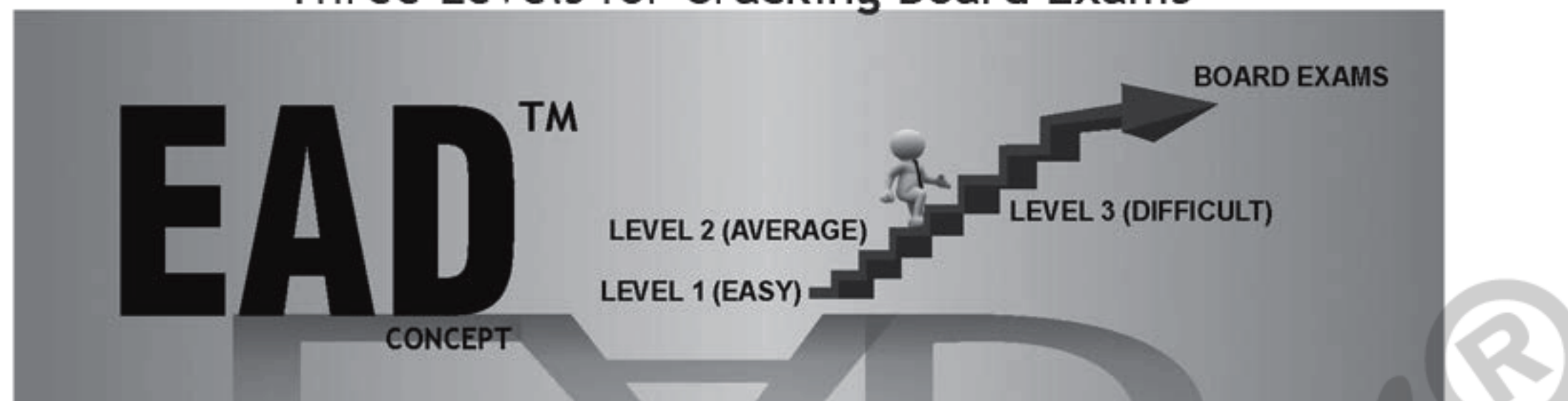
Best of luck and God bless you.

Chairperson  
CBSE

*All the best!!*

# PREFACE

## Three Levels for Cracking Board Exams



The **EAD** Latest Sample Papers is a step-by-step study material for preparing the students for the Board Examination as per the new pattern. This text has been designed to assist the students to crack the Board Examination with the right practice and approach to the latest pattern of questions as asked by the CBSE. In accordance with this rationale, the matter has been arranged as complete papers with three levels of difficulty: Easy, Average and Difficult (EAD).

It is advised that prior to attempting these papers, Latest CBSE Sample Paper should be examined closely to understand the latest CBSE pattern.

The first set of the papers based on 'Easy' concept contains questions of a level which a student can attempt at the start of the preparatory stage.

The next set based on 'Average' concept is graded to a level of difficulty to test mid-level preparedness for the examination.

The challenging papers allocated to the third set based on 'Difficult' concept are a test of complete preparedness for the examination.

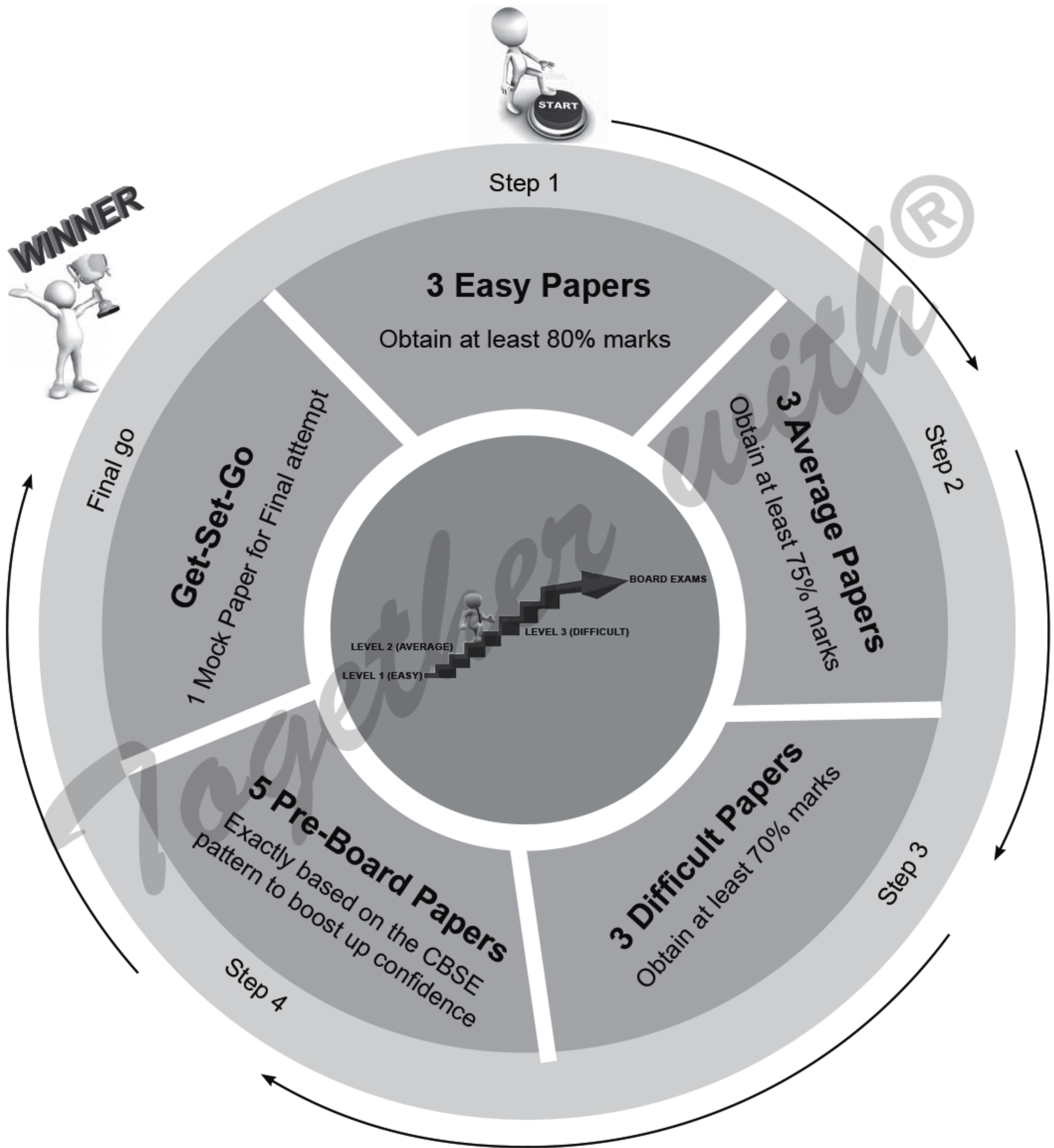
All the three levels aim at cross-checking the preparation, according to the CBSE requirement of answers.

This book includes Sample Papers which are based on Easy, Average, Difficult concept respectively and Pre-Board papers. Answers to unsolved papers are available through QR Scanner given at the end of paper and also at [gowebrachnasagar.com](http://gowebrachnasagar.com).

Mock Paper has also been given at the end for a final-go. Scan QR code to get CUET Sample Papers.

The EAD Sample Papers have been prepared by a panel comprising experienced teachers, tabulators and examiners, who have jointly provided a child-friendly approach to prepare the students for the forthcoming Board Examination, as per the vision of the CBSE.

# HOW TO ATTEMPT (EASY, AVERAGE AND DIFFICULT) SAMPLE PAPERS





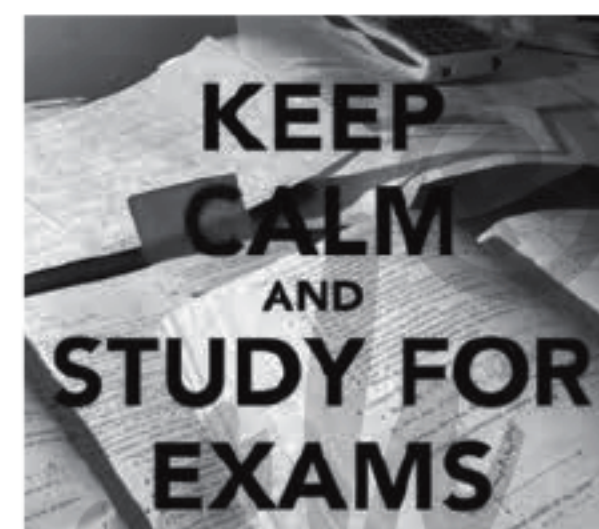
## TIPS TO CRACK BOARD EXAMS

- **Manage Your Time**

One important thing to consider is learning proper time management skills. Make a daily schedule that you must follow. Study subjects that you want to retain in memory during the morning hours when the mind is fresh. Invest minimum 8 hours in a day for studies. Equal time should be devoted to each subject so that every subject is covered.

- **Set-up a Routine with a Balanced Study Schedule**

Practice 15 + 1 CBSE Sample Papers (EAD) for Boards of all subjects attempting one paper each day before the final exam. Always balance heavy subjects with lighter subjects to not feel exhausted early. Always mix and match your subjects to stay away from monotony.



- **Track Your Common Mistakes**

Everyone has their own unique weaknesses. So, it is essential to figure out the mistakes that you make repeatedly and work on eliminating them.

- **Understanding of the Questions**

Some questions in subjects like Mathematics and Science could be tricky. So understanding the question before answering them is important.

- **Preparation of Short Notes**

It should be nature of students to prepare notes on every topic as they cover them. Prepare separate notes for each chapter and maintain a different note-book for every subject.

- **Remove Distractions**

Try staying away from social media platforms like Twitter, Facebook, and Instagram and so on at least before 3 Months of your exams as they take away much of your precious time.

- **Have a Positive Approach**

Both when studying and when actually sitting for an exam, attitude matters. A positive attitude keeps your mind open, it keeps your body relaxed, and it makes it easier for you to concentrate and recall what you have learned.

- **Drink More Water and Eat Healthy Food**

Drinking ample water (6-8 glasses a day), and eating healthy food is an important part of giving your body energy and your mind the power it needs.

- **Include a Small Fun Break in Your Schedule to Relax Your Body**

Breaks are not just for the hour or so leading up to your test. Even when you are studying hard for the most important test of your life, you need to take some breaks.

# WORD TO PARENTS

Today, the need of the hour is to take an approach towards studies that is more interesting and engaging making a kid's study habits more productive while exploring strategies that work for them. As a parent, it becomes your responsibility to figure out their challenges and the reason behind it to come up with a solution that makes their lives easy!

It is indeed true to state that - All work and no play makes Jack a dull boy.

Here are few tips or advice to all the parents:

- Studying for hours at a stretch can make it a boring exercise for your kids. Make sure your kid takes breaks in between to refresh their brain.
- Time management, goal setting and balanced self-care are important skills for the real world. Helping your child thrive in school prepares them for all of life's challenges.
- Parents should **never allow unchecked, uncontrolled, unsupervised access to the internet and social networking websites**, especially Facebook, Instagram, Twitter & Google chats to their children. A careful combination of firmness and leniency should be used.
- Be patient with your child, give off-the-cuff remarks or jump to conclusions without listening to him / her. Give your child time, advice and love and see how beautifully you can ward off all the negative thoughts of your child.

The biggest takeaway is that, as a parent or guardian, you want your child to succeed and have the best education possible.

So ALL THE BEST to you MENTORS!!

With your strong backing, we are sure your child will put in her best in her board exams this year, and not let stress about her future overwhelm her present. Bless your children from our side and wish them good luck for their exams. Meanwhile, here are some things that you need to ensure for your board exam-appearing child:

1. You along with your child must **check the location of exam centre at least a day prior** to the commencement of the examination.
2. Ensure your child goes to the examination center **wearing school uniform** only, and carrying school ID card.
3. Take care that your child is **adequately rested** on the day of exams and is taking nutritious food throughout.
4. Check that your child is **carrying only - admit card, school identity card, pen, pencil, eraser, scale, sharpener**; all these must be carried in a **transparent pouch** in which contents are visible from the outside.
5. Make doubly sure that your child is **not carrying mobile, wallet, purse, etc.** to the examination center.

6. Alert your child to **follow all instructions given by invigilators, especially those regarding the method of writing Roll Number** in Answer Book.
7. Discuss with your child about the **consequences of indulging in unfair means or unethical practises during examination**, and make them pledge not to do so.
8. Explain to your child and make them commit to **not indulge in spreading rumors and not believing in fake videos and messages** uploaded on social media.
9. Make your child aware of the constant need to **maintain discipline in the examination centre**.
10. **If your child comes under Benchmark Disabilities**, then be aware that the Board has made provisions for your child as per circular number No. CBSE/COORD/112233/2019 dated 12th April, 2019
11. **If your child is a Diabetic**, then be aware that the Board has made provisions for your child as per circular number CBSE/Coord/ASC/112567/2046 dated 21.02.2017





# केन्द्रीय माध्यमिक शिक्षा बोर्ड

(शिक्षा मंत्रालय, भारत सरकार के अधीन एक स्वायत्त संगठन)

**CENTRAL BOARD OF SECONDARY EDUCATION**

(An Autonomous Organisation Under the Ministry of Education, Govt. of India)



No.: CBSE/Academic/JS(PMS)/ 2022

16<sup>th</sup> September, 2022

## Notification

**Subject: Sample Question Papers for Classes X & XII for the current Academic Session 2022-23.**

The Sample Question Papers (SQPs) for classes X and XII for the academic session 2022-23 are now available at the following links:

[https://cbseacademic.nic.in/SQP\\_CLASSX\\_2022-23.html](https://cbseacademic.nic.in/SQP_CLASSX_2022-23.html)

[https://cbseacademic.nic.in/SQP\\_CLASSXII\\_2022-23.html](https://cbseacademic.nic.in/SQP_CLASSXII_2022-23.html)

The Board issues Sample Question Papers (SQPs) and Marking Schemes for classes X and XII to provide a broad template to serve as a guide for ensuring uniformity and proper coverage of the curricula. Further, SQPs give a broad understanding about the Question Paper Design and need to be used for classroom teaching and learning activities with an overall focus on promoting the application of concepts in real-life and holistic learning.

(Dr. Joseph Emmanuel)  
Director (Academics)



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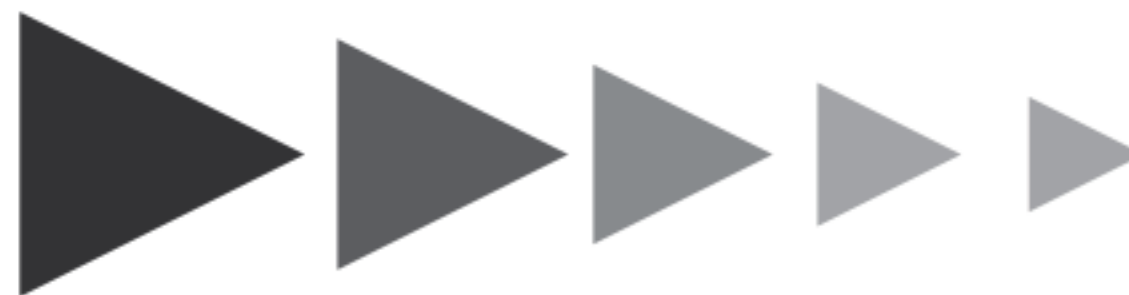


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**NOTE: FOR ANSWERS TO UNSOLVED PAPERS, YOU CAN ALSO VISIT [gowebrachnasagar.com](http://gowebrachnasagar.com). CREATE YOUR ID AND GET ACCESS TO ANSWERS.**



Time Allowed: 3 hours]

[Maximum Marks: 70

**General Instructions:**

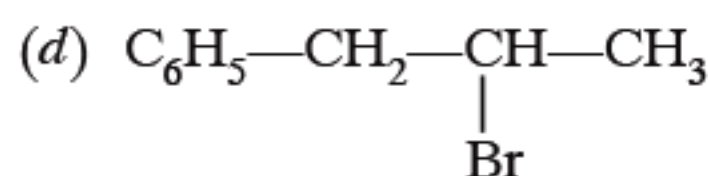
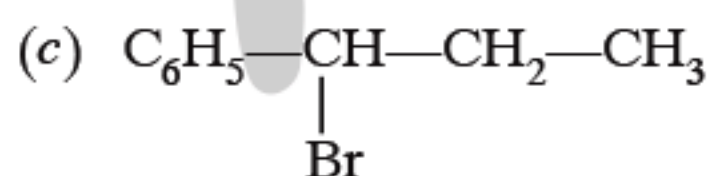
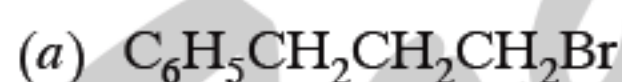
Read the following instructions carefully.

- There are 35 questions in this question paper with internal choice.
- Section A consists of 18 multiple-choice questions carrying 1 mark each.
- Section B consists of 7 very short answer questions carrying 2 marks each.
- Section C consists of 5 short answer questions carrying 3 marks each.
- Section D consists of 2 case-based questions carrying 4 marks each.
- Section E consists of 3 long answer questions carrying 5 marks each.
- All questions are compulsory.
- Use of log tables and calculators is not allowed.

**Section-A**

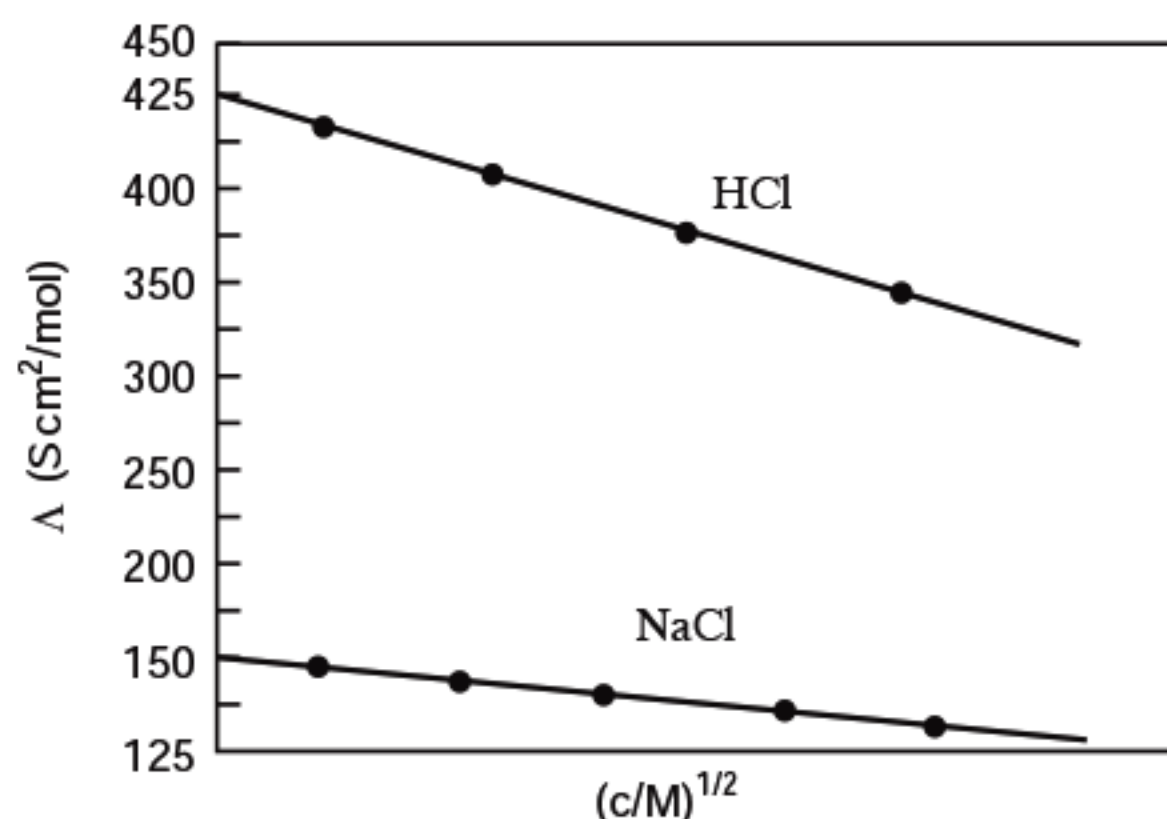
The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. The reaction of  $\text{C}_6\text{H}_5\text{—CH=CH—CH}_3$  with HBr produces

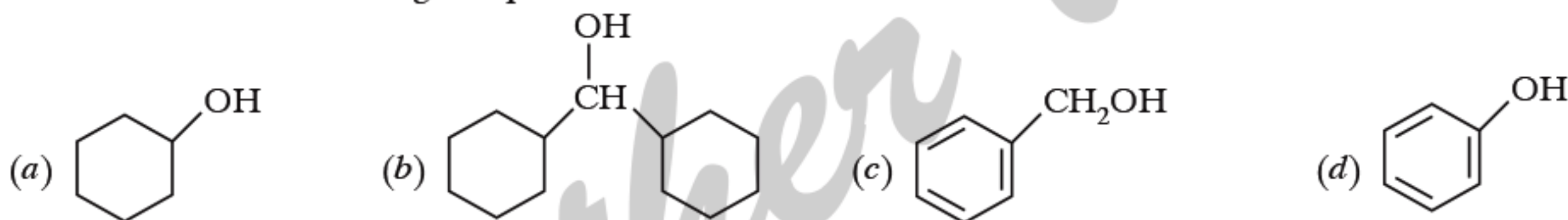


2. A primary alkyl halide would prefer to undergo \_\_\_\_\_.
- (a)  $\text{S}_{\text{N}}1$  reaction      (b)  $\text{S}_{\text{N}}2$  reaction      (c)  $\alpha$ -Elimination      (d) Racemisation
3. Which set of ions exhibit specific colours? (Atomic number of Sc = 21, Ti = 22, V = 23, Mn = 25, Fe = 26, Ni = 28, Cu = 29 and Zn = 30)
- (a)  $\text{Sc}^{3+}$ ,  $\text{Ti}^{4+}$ ,  $\text{Mn}^{3+}$       (b)  $\text{Sc}^{3+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Ni}^{2+}$       (c)  $\text{V}^{3+}$ ,  $\text{V}^{2+}$ ,  $\text{Fe}^{3+}$       (d)  $\text{Ti}^{3+}$ ,  $\text{Ti}^{4+}$ ,  $\text{Ni}^{2+}$
4. Rate constant ' $k$ ' for a certain reaction is  $2.3 \times 10^{-5} \text{ L mol}^{-1} \text{ s}^{-1}$ . Order of reaction is
- (a) 0      (b) 1      (c) 2      (d) 3

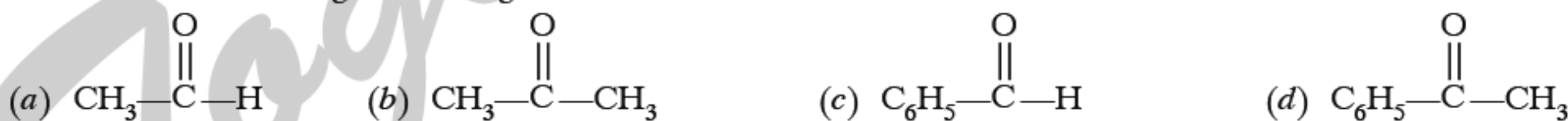
5. The molar conductivity of HCOOH at infinite dilution is  $400 \text{ S cm}^2/\text{mol}$  using the graph and given information,  $\Lambda_m^\circ \text{ HCOONa}$  will be



- (a)  $100 \text{ S cm}^2 \text{ mol}^{-1}$  (b)  $115 \text{ S cm}^2 \text{ mol}^{-1}$  (c)  $150 \text{ S cm}^2 \text{ mol}^{-1}$  (d)  $125 \text{ S cm}^2 \text{ mol}^{-1}$
6. The decomposition of  $\text{NH}_3$  on platinum surface is zero order reaction. If  $k = 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$ , the rate of production of  $\text{H}_2$  is
- (a)  $2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$  (b)  $7.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$   
 (c)  $5.0 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$  (d)  $10.0 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$
7. Propanamide on reaction with bromine in aqueous NaOH gives:
- (a) Propanamine (b) Etanamine (c) N-Methylethanamine (d) Propanenitrile
8. Ambidentate ligands like  $\text{NO}_2^-$  and  $\text{SCN}^-$  are:
- (a) unidentate (b) didentate (c) polydentate (d) has variable denticity
9. Which one of the following compounds has the most acidic nature?

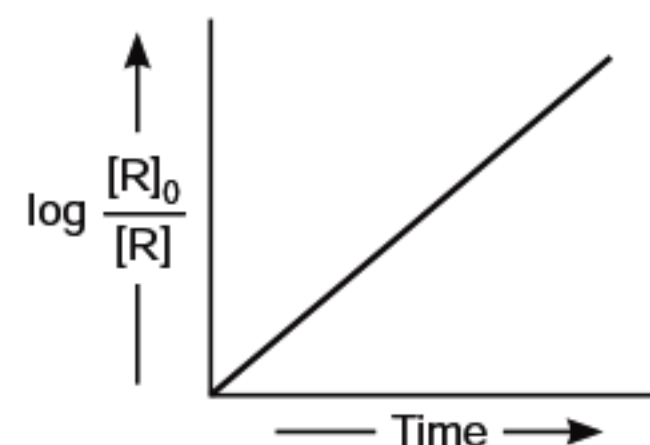


10. IUPAC name of product formed by reaction of methylamine with two moles of ethyl chloride is:
- (a) N,N-Dimethyl ethanamine (b) N,N-Diethyl methanamine  
 (c) N-Methyl ethanamine (d) N-Ethyl-N-Methyl ethanamine
11. Which of the following does not give iodoform test?



12. The slope of the line shown in graph is equal to

(a)  $k$  (b)  $\frac{k}{2.303}$   
 (c)  $-\frac{k}{2.303}$  (d)  $-k$



13. The formula of the coordination compound Tetraammineaquachloridocobalt(III) chloride is
- (a)  $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Cl}]\text{Cl}_2$  (b)  $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Cl}]\text{Cl}_3$   
 (c)  $[\text{Co}(\text{NH}_3)_2(\text{H}_2\text{O})\text{Cl}]\text{Cl}_2$  (d)  $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Cl}]\text{Cl}$
14. Toluene to benzaldehyde can be converted with the help of
- (a)  $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4$  (b)  $\text{KMnO}_4/\text{H}_2\text{SO}_4$   
 (c)  $\text{CrO}_2\text{Cl}_2$  (d)  $\text{KMnO}_4/\text{KOH}$

In the following questions (Q. No. 15 – 18), a statement of assertion followed by statement of a reason is given. Choose the correct answer out of the following choices.

- (a) Both A and R are true and R is the correct explanation of A.  
 (b) Both A and R are true but R is not the correct explanation of A.  
 (c) A is true but R is false.  
 (d) A is false but R is true.

15. Assertion (A): Diethyl ether has dipole moment.

Reason (R): Diethyl ether is a linear molecule.

16. Assertion (A): Globular proteins are soluble in water.

Reason (R): Keratin is fibrous protein.

17. Assertion (A):  $\text{Cu}^{2+}$  is paramagnetic,  $\text{Cu}^+$  is diamagnetic.

Reason (R):  $\text{Cu}^{2+}$  has one unpaired electron,  $\text{Cu}^+$  does not.

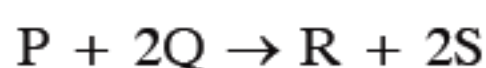
18. Assertion (A): Ethyl amine is more basic than Aniline.

Reason (R):  $pK_b$  of ethyl amine is higher than that of Aniline.

### Section-B

This section contains 7 questions with internal choice in two questions. The following questions are very short answer type and carry 2 marks each.

19. The following results have been obtained during the kinetic studies of the reaction:



Exp.	Initial P(mol/L)	Initial Q (mol/L)	Init. Rate of Formation of R ( $\text{M min}^{-1}$ )
1	0.10	0.10	$3.0 \times 10^{-4}$
2	0.30	0.30	$9.0 \times 10^{-4}$
3	0.10	0.30	$3.0 \times 10^{-4}$
4	0.20	0.40	$6.0 \times 10^{-4}$

Determine the rate law expression for the reaction.

20. Define the following:

(a) Invert sugar

(b) Nucleoside

OR

(a) What happens when glucose reacts with  $\text{Br}_2(\text{aq})$ ? Write chemical reaction involved.

(b) Identify the globular and fibrous protein from the following:

Albumin and Keratin

21. With the help of resonating structures explain the effect of presence of nitro group at ortho position in chlorobenzene.

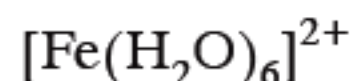
OR

Carry out the following conversions in not more than 2 steps:

(a) Aniline to chlorobenzene

(b) 2-bromopropane to 1-bromopropane

22. (a) Write the electronic configuration of iron ion in the following complex ion and predict its magnetic behaviour :



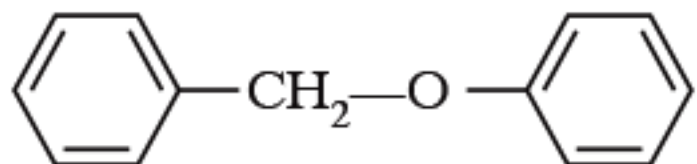
(b) Write the IUPAC name of the coordination complex:  $[\text{CoCl}_2(\text{en})_2]\text{NO}_3$



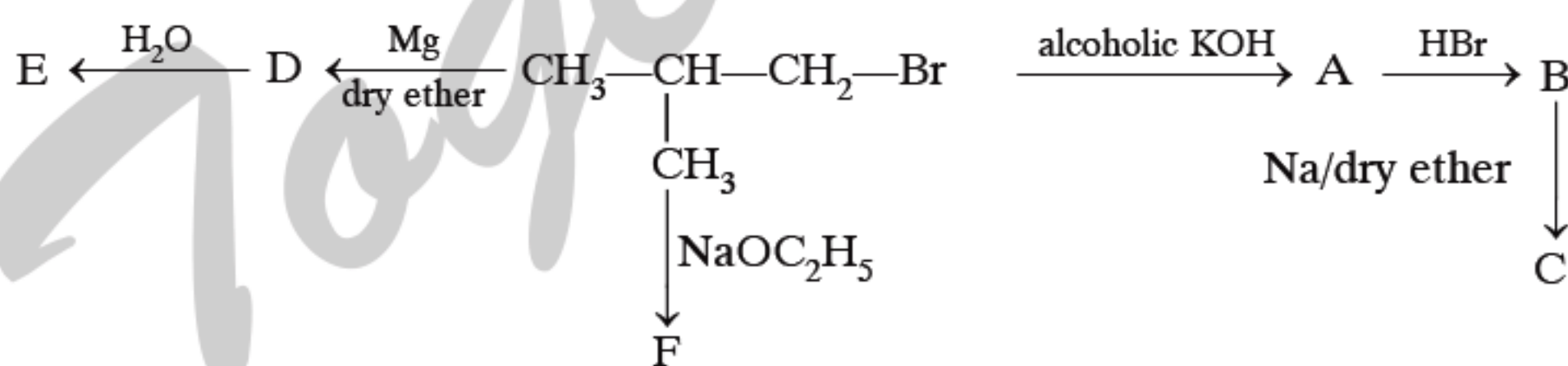
23. Solutions of two electrolytes 'A' and 'B' are diluted. The  $\Lambda_m$  of 'B' increases 1.5 times while that of A increases 25 times. Which of the two is a strong electrolyte? Justify your answer. Graphically show the behavior of 'A' and 'B'.
24. The C-14 content of an ancient piece of wood was found to have three tenths of that in living trees. How old is that piece of wood? ( $\log 3 = 0.4771$ ,  $\log 7 = 0.8540$ , Half-life of C-14 = 5730 years )
25. Arrange the following in the increasing order of their property indicated:
- (a) Benzoic acid, Phenol, Picric acid, Salicylic acid ( $pK_a$  values).
- (b) Acetaldehyde, Acetone, Methyl tert. butyl ketone (reactivity towards  $\text{NH}_2\text{OH}$ ).

### Section-C

This section contains 5 questions with internal choice in two questions. The following questions are short answer type and carry 3 marks each.

26. Give the structures of final products expected from the following reactions:
- (a) Hydroboration of propene followed by oxidation with  $\text{H}_2\text{O}_2$  in alkaline medium.
- (b) Dehydration of  $(\text{CH}_3)_3\text{C}-\text{OH}$  by heating it with 20%  $\text{H}_3\text{PO}_4$  at 358 K.
- (c) Heating of  with HI.
27. (a)  $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$  gives 2 moles of AgCl when treated with excess of  $\text{AgNO}_3$  solution. Write structural formula of the complex.
- (b) Write hybridization, shape and magnetic property of  $[\text{Fe}(\text{CN})_6]^{3-}$ .  
[Atomic number of Fe = 26].
28. A 0.01 m aqueous solution of  $\text{AlCl}_3$  freezes at  $-0.068^\circ\text{C}$ . Calculate the percentage of dissociation.  
[Given:  $K_f$  for Water =  $1.86 \text{ K kg mol}^{-1}$ ]
29. Give reasons for any 3 of the following observations:
- (a) Aniline cannot be prepared by the ammonolysis of chlorobenzene under normal conditions.
- (b) N-ethylethanamine boils at 329.3 K and butanamine boils at 350.8 K, although both are isomeric in nature.
- (c) Acylation of aniline is carried out in the presence of pyridine.
- (d) Aniline becomes coloured on long standing.

30. Identify A, B, C, D, E and F in the following:



OR

The following haloalkanes are hydrolysed in presence of aq. KOH:

- (i) 2-chlorobutane
- (ii) 3-chloro-3-methylhexane

Which of the above is most likely to give

- (a) an inverted product
- (b) a racemic mixture?
- (c) Write the products formed.

## Section–D

The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

### VITAMINS [By Swetha Shiv Kumar August 21, 2022, HT]

31. There are 13 vitamins known till today. Four of which are fat soluble (A, D, E, K) and rest of which are water soluble ( $B_1$ ,  $B_2$ ,  $B_3$ ,  $B_5$ ,  $B_6$ ,  $B_7$ ,  $B_9$ ,  $B_{12}$ , C). Let's know the history how vitamins were discovered.

By the end of mid-1800 scientists had discovered that pathogens caused various diseases. It was assumed that patchy skin, falling eye-sight etc. is also caused by germs instead of vitamin deficiency. Dutch Bio Scientist Dr. Christiaan Eijkman reported in 1895, that chickens that ate polished rice developed beri-beri. He was awarded Noble Prize in 1929 for his contribution in discovery of vitamins. 'Vita' (Latin—for important to life), amine (a specific group which Funk believed is present in all vitamins). In the beginning vitamin C was called Scurvy Vitamin, Vitamin-B was called Beri-beri vitamin when rats were fed a diet heavy in lard and olive oil, they died but with the addition of tiny amount of butter fat they survived. McCollum called vitamin in butter fat. Fat soluble Vitamin 'A', Vitamin  $B_{12}$  and Vitamin D were discovered later. Now we also know vitamin E, K and H also.

**Answer the following questions:**

- Name four vitamins that are stored in liver and adipose (fat storing) tissues.
- Out of B, C and  $B_{12}$  which vitamin cannot be stored in our body and why?
- Name a vitamin which helps in blood clotting and name source of this vitamin.

**OR**

Name a vitamin which is fat soluble and anti-oxidant. What are sources of this vitamin and its deficiency disease?

32. Electrolytes dissociate into ions. In case of electrolytes if we determine their molar mass using colligative property, the value of molar mass is found to be abnormal because colligative property depends on number of ions. Greater the number of ions, more will be colligative property. van't Hoff factor ( $i$ ) is ratio of normal molar mass to the abnormal molar mass. It is also equal to ratio of observed colligative property to the calculated colligative property.

A student determined value of ' $i$ ' at various concentration of NaCl, KCl,  $MgSO_4$  and  $K_2SO_4$ . The values are given in the following table.

**Table: Values of van't Hoff factor,  $i$ , at Various Concentrations for NaCl, KCl,  $MgSO_4$  and  $K_2SO_4$ .**

Salt	*Values of $i$			van't Hoff Factor $i$ for complete dissociation of solute
	0.1 m	0.01 m	0.001 m	
NaCl	1.87	1.94	1.97	2.00
KCl	1.85	1.94	1.98	2.00
$MgSO_4$	1.21	1.82	1.82	2.00
$K_2SO_4$	2.32	2.84	2.84	3.00

\* represent  $i$  values for incomplete dissociation.

**Answer the following questions based on above table.**

- How is van't Hoff factor related to molality and why?
- What is value of ' $i$ ' in case of (i) electrolyte (ii) non-electrolyte?
- Determine the amount of  $CaCl_2$  ( $i = 2.47$ ) dissolved in 2.5 L of water such that its osmotic pressure is 0.75 atm at 27°C. [ $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$ ] [Ca 40u, Cl = 35.5 u]

**OR**

Determine the osmotic pressure of a solution prepared by dissolving 25 mg of  $K_2SO_4$  in 2 L solution at 25°C assuming it is completely ionised.

[ $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$ , K = 39 u, S = 32 u, O = 16 u]

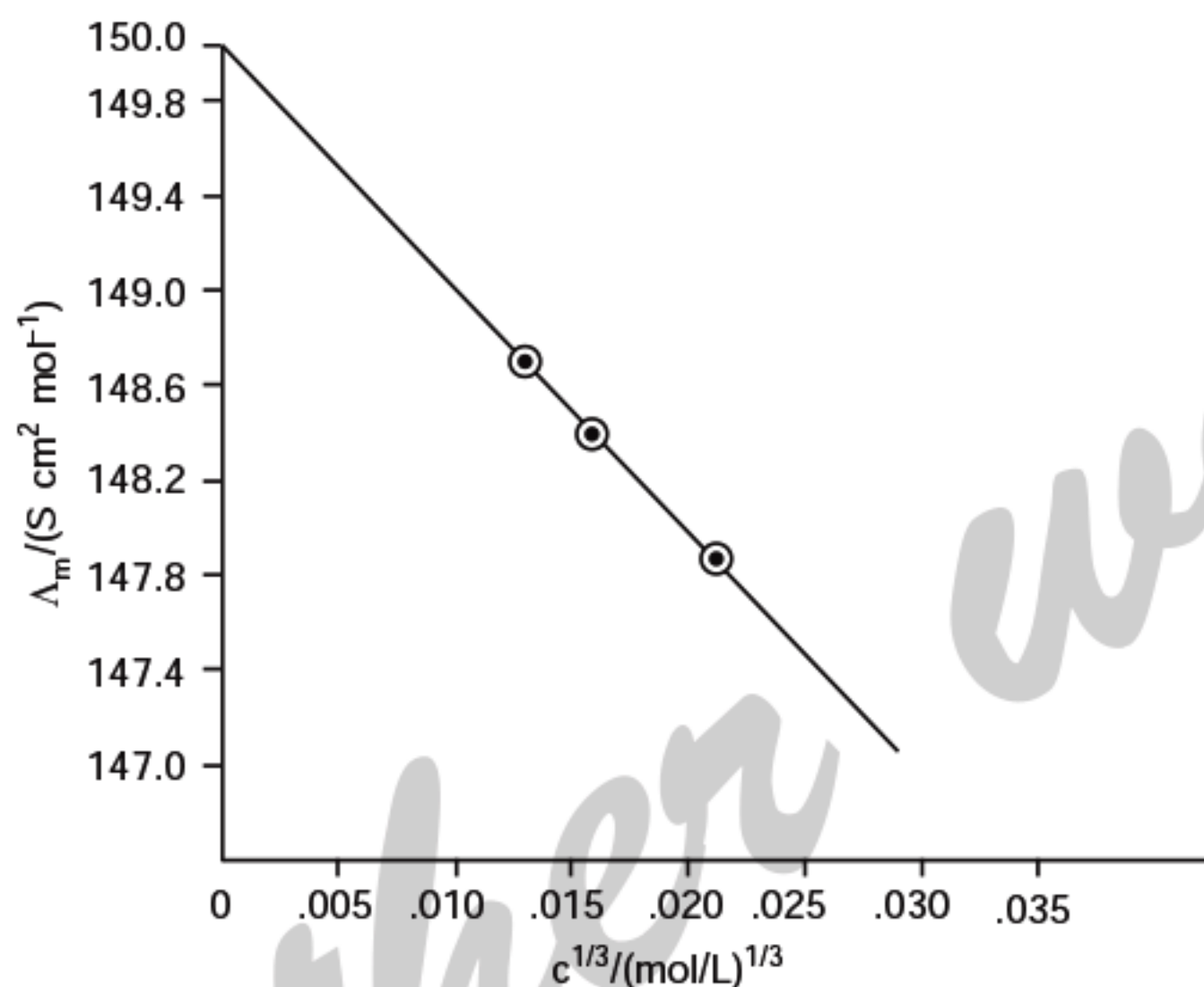
### Section-E

The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.

33. (a) State Kohlrausch law.  
 (b) Calculate the emf of the following cell at 298 K:  
 $\text{Al(s)}/\text{Al}^{3+}(0.15\text{M})\parallel\text{Cu}^{2+}(0.025\text{M})/\text{Cu(s)}$   
 [Given  $E^\circ(\text{Al}^{3+}/\text{Al}) = -1.66\text{ V}$ ,  $E^\circ(\text{Cu}^{2+}/\text{Cu}) = 0.34\text{ V}$ ,  $\log 0.15 = -0.8239$ ,  $\log 0.025 = -1.6020$ ]

OR

- (a) On the basis of  $E^\circ$  values identify which amongst the following is the strongest oxidising agent.
- |  |                              |
|--|------------------------------|
| $\text{Cl}_2(\text{g}) + 2e^- \longrightarrow 2\text{Cl}^-$  | $E^\circ = +1.36\text{ V}$ , |
| $\text{MnO}_4^- + 8\text{H}^+ + 5e^- \longrightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$               | $E^\circ = +1.51\text{ V}$   |
| $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6e^- \longrightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$ | $E^\circ = +1.33\text{ V}$   |
- (b) The following figure, represents variation of  $(\Lambda_m)$  vs  $\sqrt{c}$  for an electrolyte. Here  $\Lambda_m$  is the molar conductivity and  $c$  is the concentration of the electrolyte.

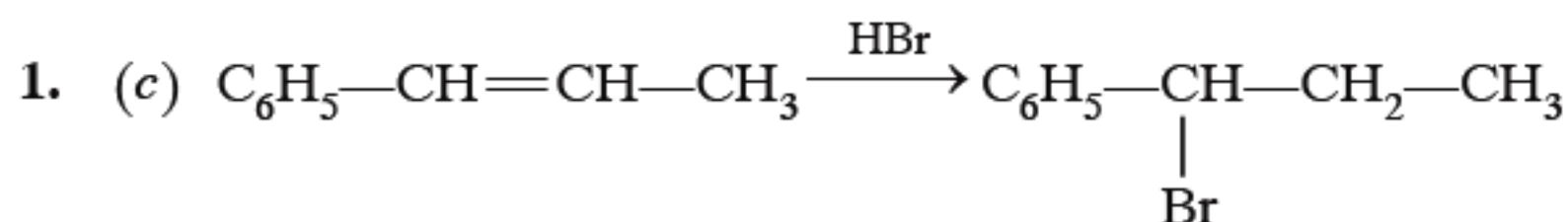


- (a) Define molar conductivity.  
 (b) Identify the nature of electrolyte on the basis of the above plot. Justify your answer.  
 (c) Determine the value of  $\Lambda_m^\circ$  for the electrolyte.  
 (d) Show how to calculate the value of A for the electrolyte using the above graph.
34. An organic compound 'A'  $\text{C}_8\text{H}_6$  on treatment with dilute  $\text{H}_2\text{SO}_4$  containing mercuric sulphate gives compound 'B'. This compound 'B' can also be obtained from a reaction of benzene with acetyl chloride in presence of anhydrous  $\text{AlCl}_3$ . 'B' on treatment with  $\text{I}_2$  in aq.  $\text{KOH}$  gives 'C' and a yellow compound 'D'. Identify A, B, C and D. Give the chemical reactions involved.

OR

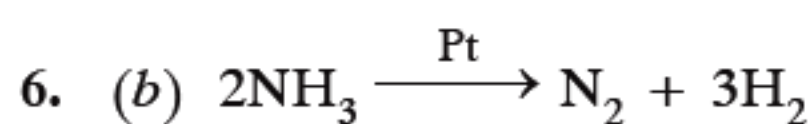
- (a) Write the reaction for cross aldol condensation of acetone and ethanal.  
 (b) How will you carry out the following conversions:  
 (i) Benzyl alcohol to phenyl ethanoic acid      (ii) Propanone to propene  
 (iii) Benzene to *m*-nitroacetophenone
35. (a) Why are fluorides of transition metals more stable in their higher oxidation state as compared to the lower oxidation state?  
 (b) Which one of the following would feel attraction when placed in magnetic field:  
 $\text{Co}^{2+}$ ,  $\text{Ag}^+$ ,  $\text{Ti}^{4+}$ ,  $\text{Zn}^{2+}$   
 (c) It has been observed that first ionization energy of 5d series of transition elements are higher than that of 3d and 4d series, explain why?  
 (d) Why Manganese has lower melting point than Chromium?  
 (e) Why do transition metals of 3d series have lower melting points as compared to 4d series?

# ANSWERS



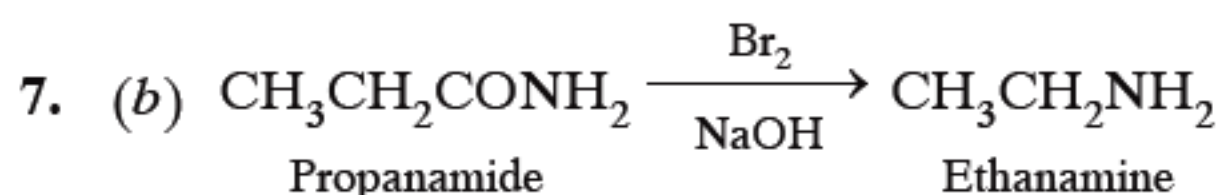
Since  $\text{C}_6\text{H}_5\text{—}\overset{\oplus}{\text{C}}\text{H—CH}_2\text{—CH}_3$  will be stabilised by resonance.

2. (b) It will undergo  $\text{S}_{\text{N}}2$  mechanism due to less steric hindrance.  
3. (c) It is due to presence of unpaired electrons.  
4. (c)  $\text{rate} = k[\text{A}]^2 \Rightarrow \text{mol L}^{-1} \text{s}^{-1} = k[\text{mol L}^{-1}]^2 \Rightarrow k = \text{mol}^{-1} \text{L s}^{-1}$   
5. (d)  $\Lambda_{\text{HCOONa}}^\circ = \Lambda_{\text{HCOOH}}^\circ + \Lambda_{\text{NaCl}}^\circ + \Lambda_{\text{HCl}}^\circ = 400 + 150 - 425 = 125 \text{ S cm}^2 \text{ mol}^{-1}$ .

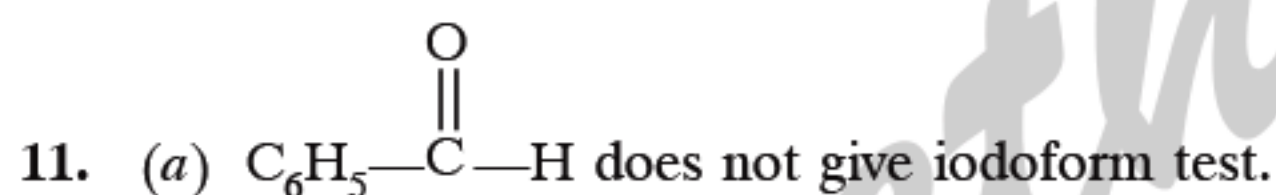


$$-\frac{d[\text{NH}_3]}{2dt} = +\frac{d[\text{N}_2]}{dt} = +\frac{1}{3} \frac{d[\text{H}_2]}{dt} = 2.5 \times 10^{-4}$$

$$\text{rate of production of H}_2 = 3 \times 2.5 \times 10^{-4} = 7.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

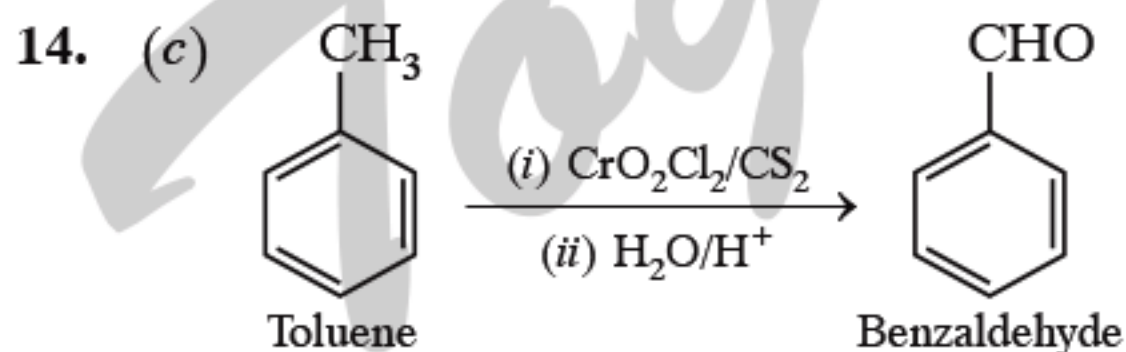


8. (a) They are unidentate  
9. (d) Because phenoxide ion is stabilised by resonance.  
10. (d)  $\text{CH}_3\text{NH}_2 + 2\text{C}_2\text{H}_5\text{Cl} \longrightarrow (\text{C}_2\text{H}_5)_2\text{NHCH}_3 + \text{HCl}$   
IUPAC name is N-Ethyl-N-Methyl ethanamine



12. (b)

13. (a)



15. (c) A is true but R is false.  
16. (b) Both A and R are true but R is not the correct explanation of A.  
17. (a) Both A and R are true and R is the correct explanation of A.  
18. (c) A is true but R is false.  
19.  $\text{P} + 2\text{Q} \longrightarrow \text{R} + 2\text{S}$

Let rate  $k = [\text{P}]^x [\text{Q}]^y$  be rate law

Dividing Exp. (1) by (3), we have

$$\frac{3.0 \times 10^{-4}}{3.0 \times 10^{-4}} = \frac{k[0.1]^x [0.10]^y}{k[0.1]^x [0.30]^y}$$

$$1 = \left(\frac{1}{3}\right)^y \Rightarrow \left(\frac{1}{3}\right)^0 = \left(\frac{1}{3}\right)^y \Rightarrow y = 0$$

Dividing Exp. (2) by (3), we have

$$\frac{9.0 \times 10^{-4}}{3.0 \times 10^{-4}} = \frac{k[0.30]^x [0.30]^y}{k[0.10]^x [0.30]^y}$$

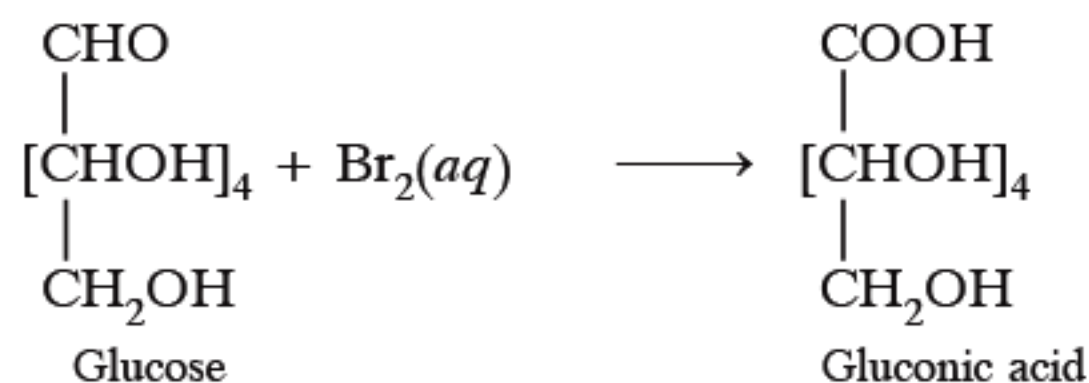
$$3 = 3 \Rightarrow x = 1$$

∴ Rate =  $k[P]$  is the rate law expression for the reaction.

20. (a) **Invert Sugar:** The mixture containing equal amount of d(+) glucose and l(-) fructose is called invert sugar.
- (b) **Nucleoside:** It consists of heterocyclic base like Adenine, guanine and cytosine. Thymine attached to ribose or deoxyribose sugar, e.g. Adenosine.

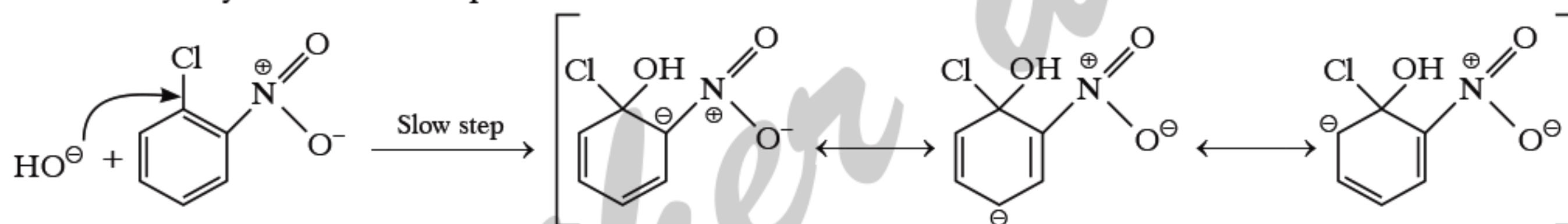
OR

- (b) Gluconic acid is formed.

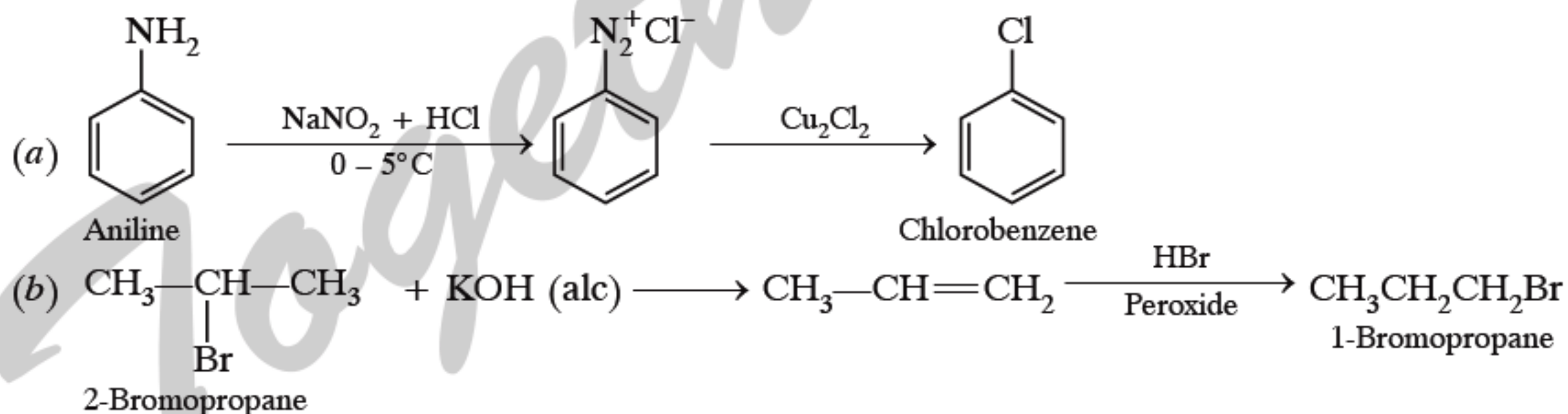


- (b) Globular protein is Albumin whereas fibrous protein is Keratin.

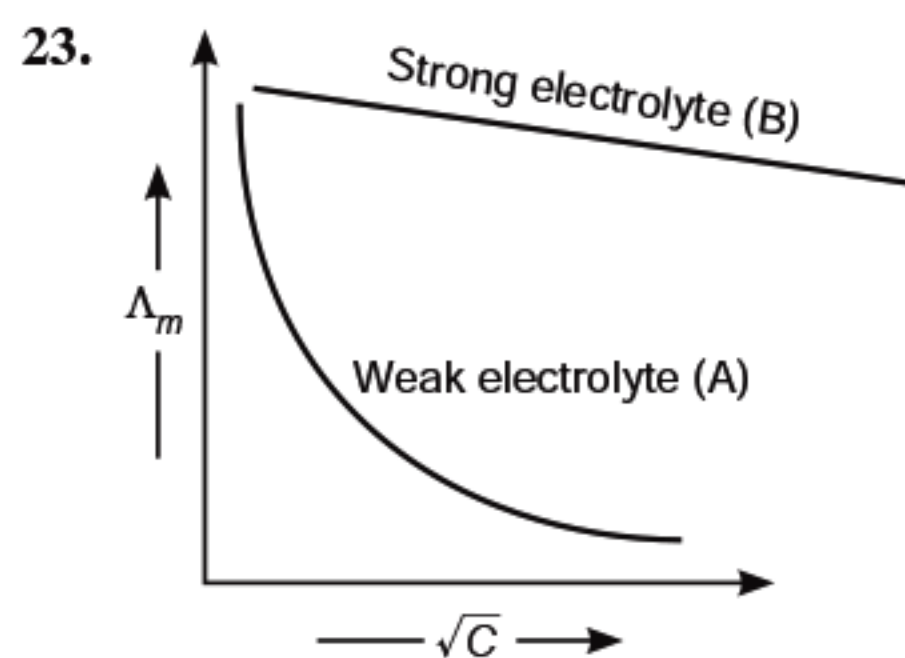
21. (a) Nitro group is electron withdrawing at ortho position, reduces electron density on benzene ring and thus reactivity towards nucleophilic substitution increases.



OR



22. (a)  $t_{2g}^4 e_g^2$ , it is paramagnetic due to presence of 4 unpaired electrons.
- (b) Dichlorido(ethane-1,2-diamine)cobalt(III) nitrate.



'A' is weak electrolyte because its  $\Lambda_m$  increases 25 times on dilution because number of ions as well as mobility of ions increases to large extent.

'B' is strong electrolyte because  $\Lambda_m$  increases 1.5 times on dilution because number of ions do not increase appreciably, only mobility of ions increases.

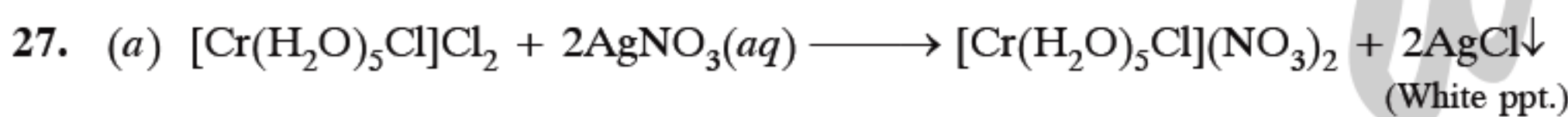
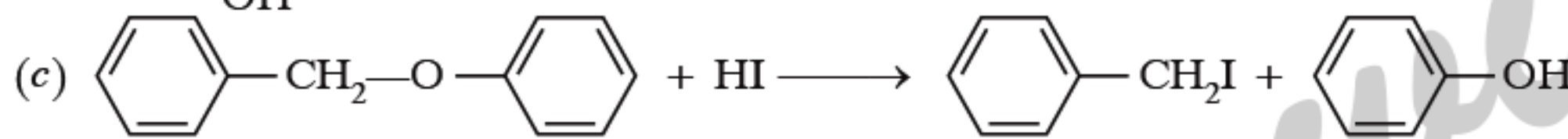
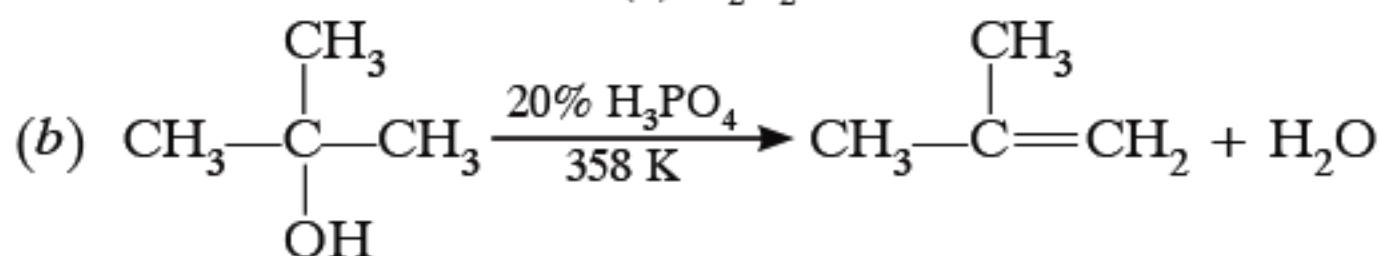
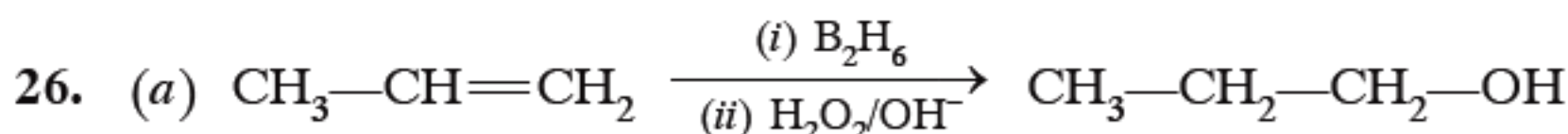
24. 
$$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{5730} \text{ year}^{-1}$$

$$t = \frac{2.303}{k} \log \frac{[R]_0}{[R]_t} = \frac{2.303}{0.693} \times 5730 \log \frac{[R]_0}{\frac{3}{10}[R]_0} = \frac{2.303 \times 5730}{0.693} \times \log \frac{10}{3}$$

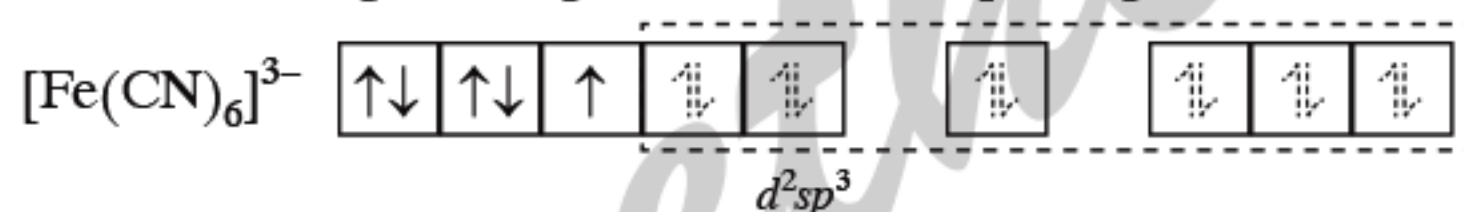
$$= 19042 \times (1 - 0.4771) = 19042 \times 0.5229 = 9957 \text{ years}$$

25. (a) Stronger the acid, lower will be value of  $pK_a$ .  
Picric acid < Salicylic acid < Benzoic acid < Phenol is order of  $pK_a$  value.

(b) Greater the steric hinderance, lesser will be reactivity towards  $\text{NH}_2\text{OH}$ .  
Methyl tert. butyl ketone < Acetone < Acetaldehyde



(b)  $[\text{Fe}(\text{CN})_6]^{3-}$   
Fe(26):  $[\text{Ar}] 4s^2 3d^6$   
Fe<sup>3+</sup>(26):  $[\text{Ar}] 4s^0 3d^5$   
CN<sup>-</sup> are strong field ligands, will cause pairing of electrons.



It has  $d^2sp^3$  hybridisation, octahedral shape and paramagnetic.

28.  $m = 0.01 \text{ m}, \Delta T_f = 0^\circ\text{C} - (-0.068^\circ\text{C}) = +0.068^\circ\text{C}$

$$\Delta T_f = i K_f \times m$$

$$0.068 = i \times 1.86 \times 0.01$$

$$i = \frac{0.068}{0.0186} = 3.656$$



$$\alpha = \frac{i - 1}{n - 1} = \frac{3.656 - 1}{4 - 1} = \frac{2.656}{3} = 0.885$$

$$\alpha = 0.885 \times 100 = 88.5\%$$

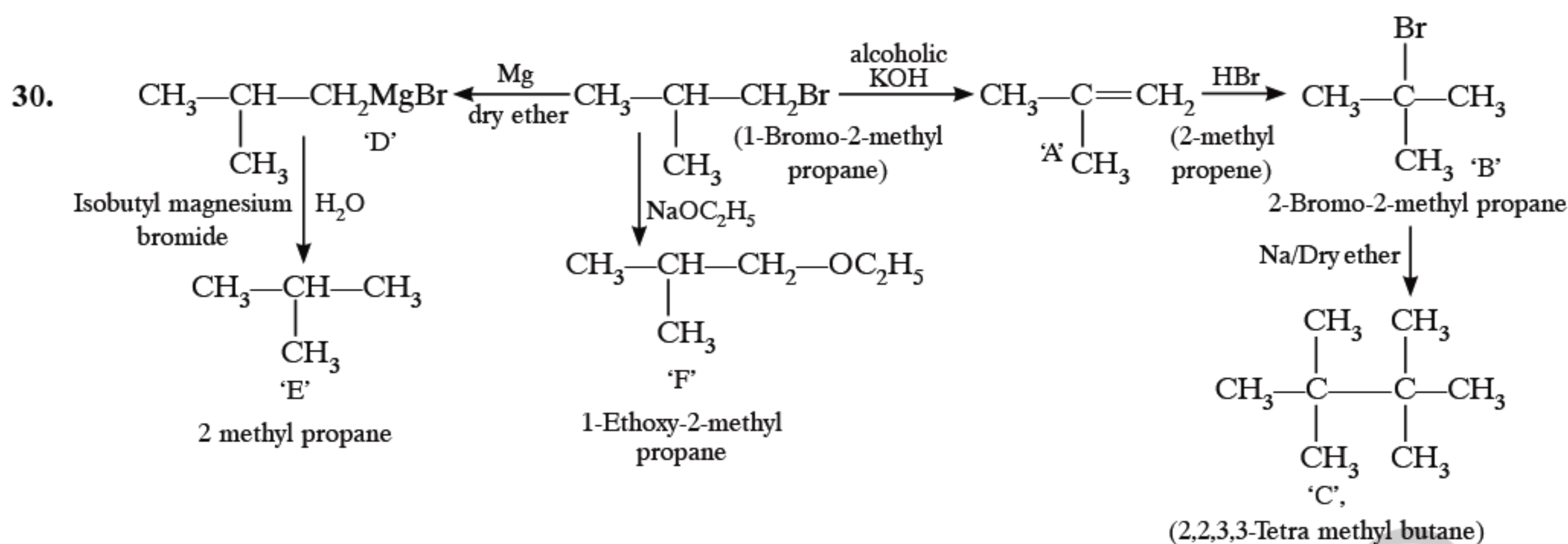
The percentage dissociation of  $\text{AlCl}_3$  is 88.5%.

29. (a) It is because chlorobenzene cannot undergo nucleophilic substitution reaction easily due to double bond character,  $\text{C}=\text{Cl}$  due to resonance.

(b) It is because N-ethyl ethanamine (2° amine) has less inter-molecular H-bonding as compared to butanamine (1° amine).

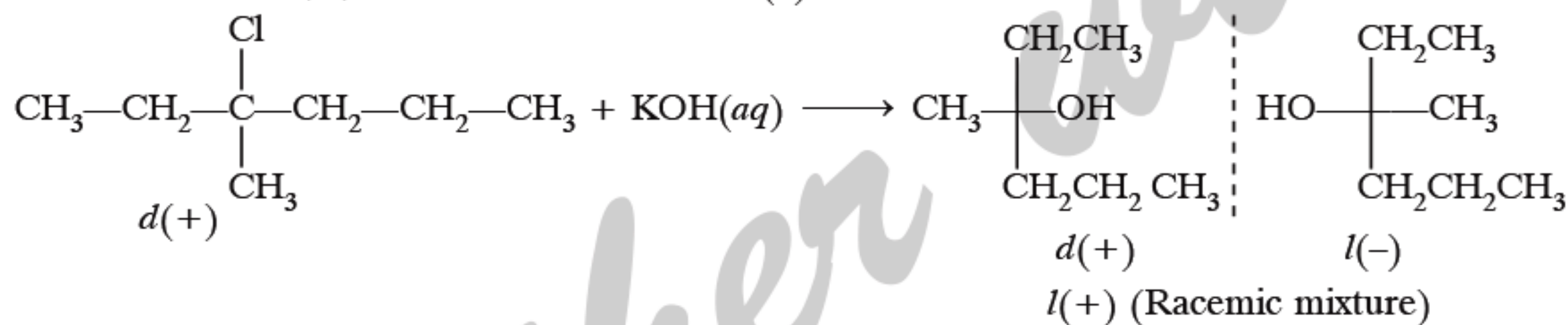
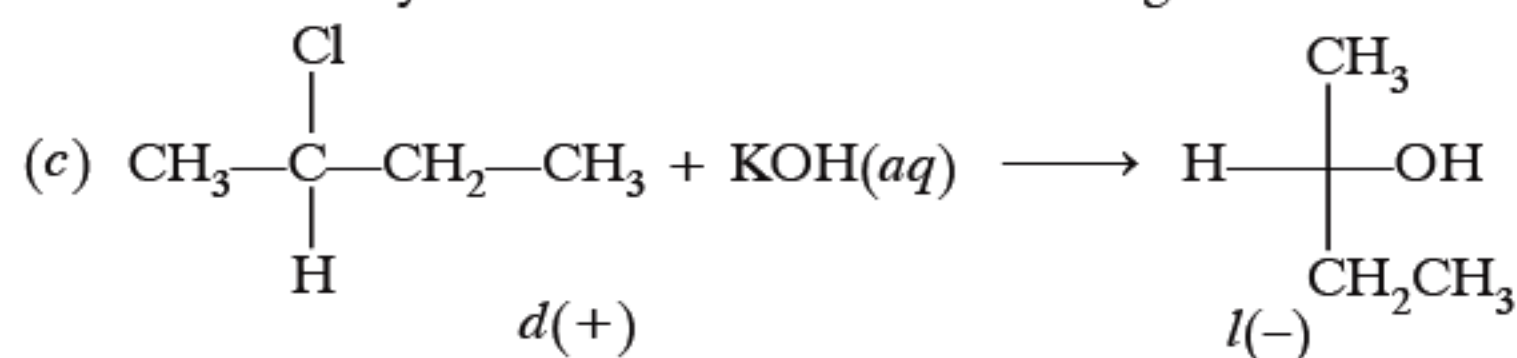
(c) Pyridine is a base reacts with HCl to form pyridinium hydrochloride so as to prevent backward reaction i.e. hydrolysis of acetanilide.

(d) It is due to oxidation in presence of air.



OR

- (a) 2-chlorobutane will give inverted product due to back side attack of  $\text{OH}^-$  following  $\text{S}_\text{N}2$  mechanism.  
 (b) 3-chloro-3-methylhexane will give racemic mixture due to formation of carbocation with equal probability of attack by  $\text{OH}^-$  from both sides leading to racemic mixture by  $\text{S}_\text{N}1$  mechanism.



31. (a) A, D, E, K are stored in liver and adipose tissues.  
 (b) B and C are water soluble vitamins, therefore, cannot be stored in our body.  
 (c) Vitamin K helps in clotting of blood. It is present in green leafy vegetables.

OR

Vitamin 'E' is fat soluble and anti-oxidant.

Its deficiency leads to loss of reproductive power.

Its sources are vegetable oils, wheat germ oil, sun flower oil, etc.

32. (a) As molality decreases, van't factor increases because degree of ionisation is inversely proportional to concentration.

- (b) (i)  $i > 1$ , (ii)  $i = 1$

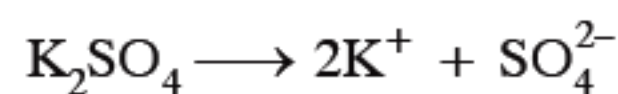
(c) 
$$\pi V = inRT = i \frac{W_B}{M_B} \times R \times T$$

$$0.75 \text{ atm} \times 2.5 \text{ L} = 2.47 \times \frac{W_B}{111} \times 0.082 \times 300 \text{ K}$$

$$W_B = \frac{0.75 \times 2.5 \times 111}{2.47 \times 24.6} = 3.425 \text{ g}$$

$$\text{No. of moles} = \frac{3.425}{111} = 0.03 \text{ mol}$$

OR



$$i = n = 3$$

$$\pi V = i n_B RT$$

$$[\because \alpha = 100\%]$$

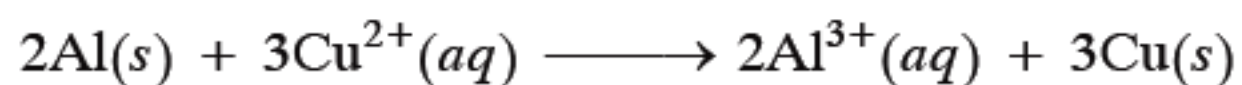
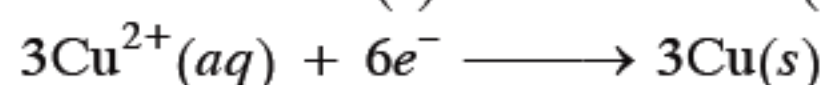
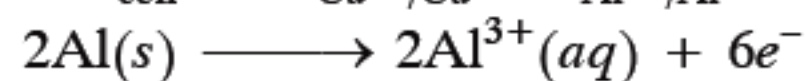
$$\pi \times 2 = 3 \times \frac{25 \times 10^{-3}}{174} \times 0.082 \times 298$$

$$\pi = \frac{3 \times 25 \times 10^{-3} \times 0.082 \times 298}{174 \times 2} = 5.27 \times 10^{-3} \text{ atm}$$

33. (a) It states, 'At infinite dilution, the limiting molar conductivity of an electrolyte is equal to the sum of contribution of each cation as well as anion, e.g.

$$\Lambda^\circ_{\text{CH}_3\text{COOH}} = \lambda^\circ_{\text{CH}_3\text{COO}^-} + \lambda^\circ_{\text{H}^+}$$

(b)  $E^\circ_{\text{cell}} = E^\circ_{\text{Cu}^{2+}/\text{Cu}} - E^\circ_{\text{Al}^{3+}/\text{Al}} = +0.34 \text{ V} - (-1.66 \text{ V}) = 2.00 \text{ V}$



$$n = 6$$

$$E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{0.0591}{6} \log \frac{[\text{Al}^{3+}]^2}{[\text{Cu}^{2+}]^3} = 2.0 \text{ V} - \frac{0.0591}{6} \log \frac{(0.15)^2}{(0.025)^3}$$

$$= 2.0 \text{ V} - \frac{0.0591}{6} [2 \log 0.15 - 3 \log 0.025]$$

$$= 2.0 \text{ V} - \frac{0.0591}{6} (2 \times -0.8239 - 3 \times -1.6020)$$

$$= 2.0 \text{ V} - \frac{0.0591}{6} (-1.6478 + 4.8062)$$

$$= 2.0 \text{ V} - 0.0311 = 1.9689 \text{ V}$$

OR

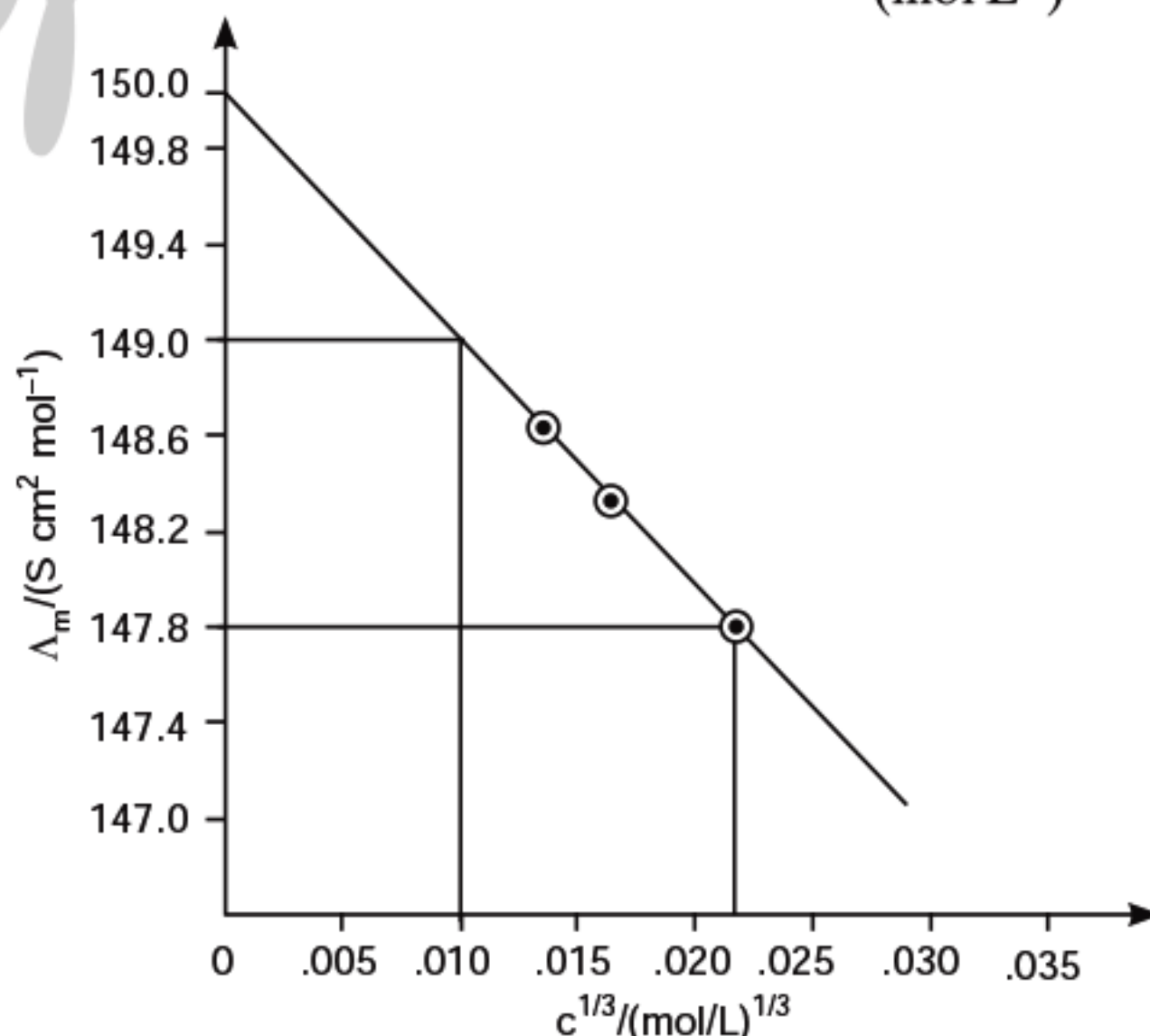
- (a)  $\text{MnO}_4^-$  is strongest oxidising agent because its reduction potential is highest.

- (b) (i) Molar conductivity is defined as conductance of the volume of solution containing 1 mole of electrolyte kept between two electrodes with area of cross section 'A' sufficient to hold electrolyte and distance of unit length.  
(ii) Strong electrolyte because for strong electrolyte  $\Lambda_m$  increases slowly with dilution, i.e. decrease in concentration.

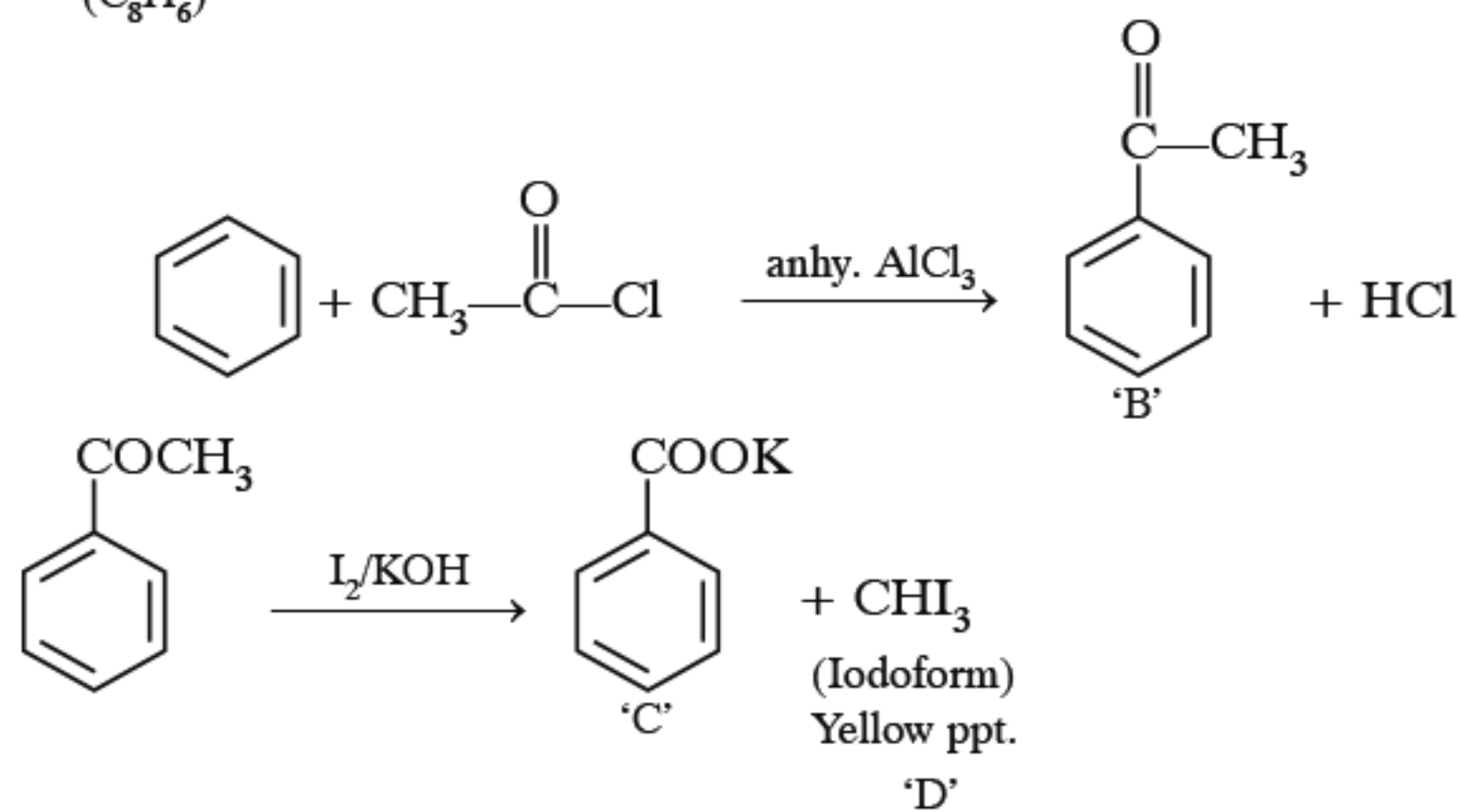
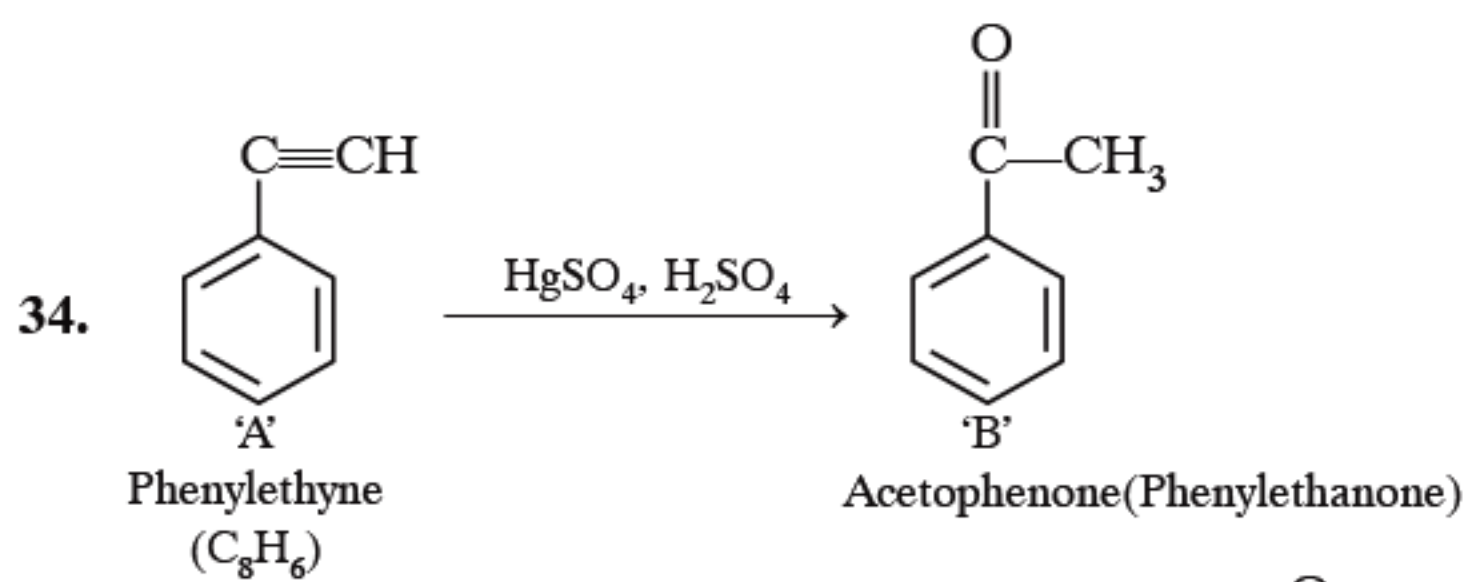
(iii)  $\Lambda_m = \Lambda_m^\circ - A\sqrt{c}$

Therefore,  $\Lambda_m^\circ = 150 \text{ S cm}^2 \text{ mol}^{-1}$

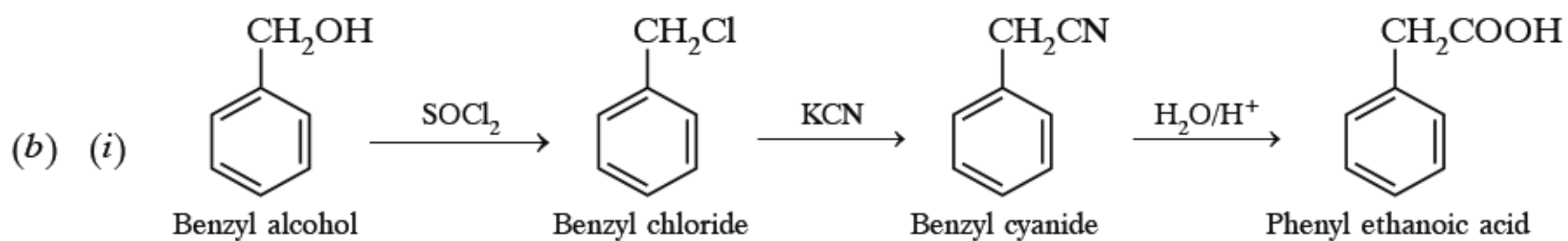
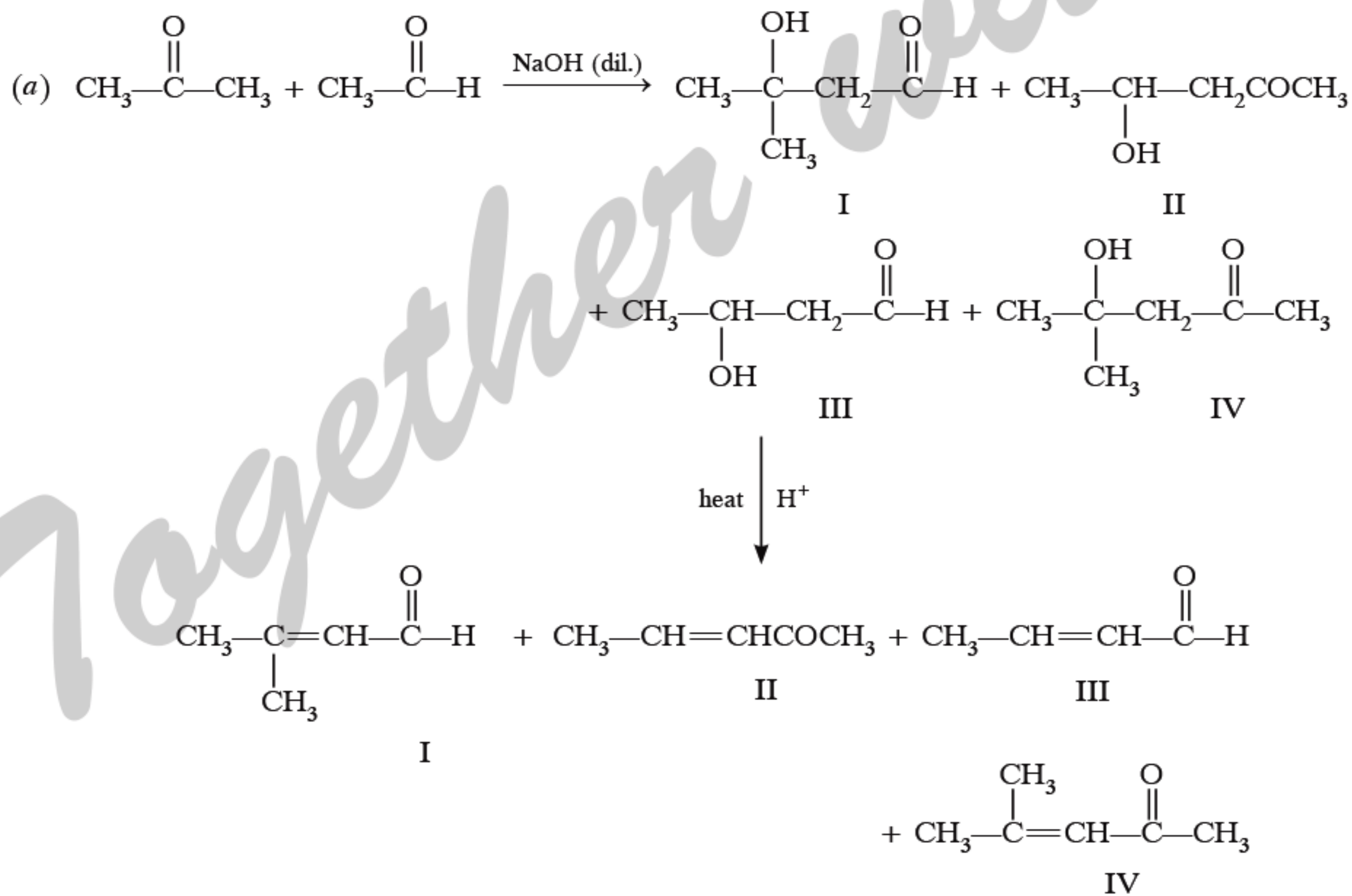
(iv)  $\text{Slope} = -A = \frac{-(149 - 147.8)}{0.010 - 0.022} = \frac{100 \text{ S cm}^2 \text{ mol}^{-1}}{(\text{mol L}^{-1})^{1/2}}$

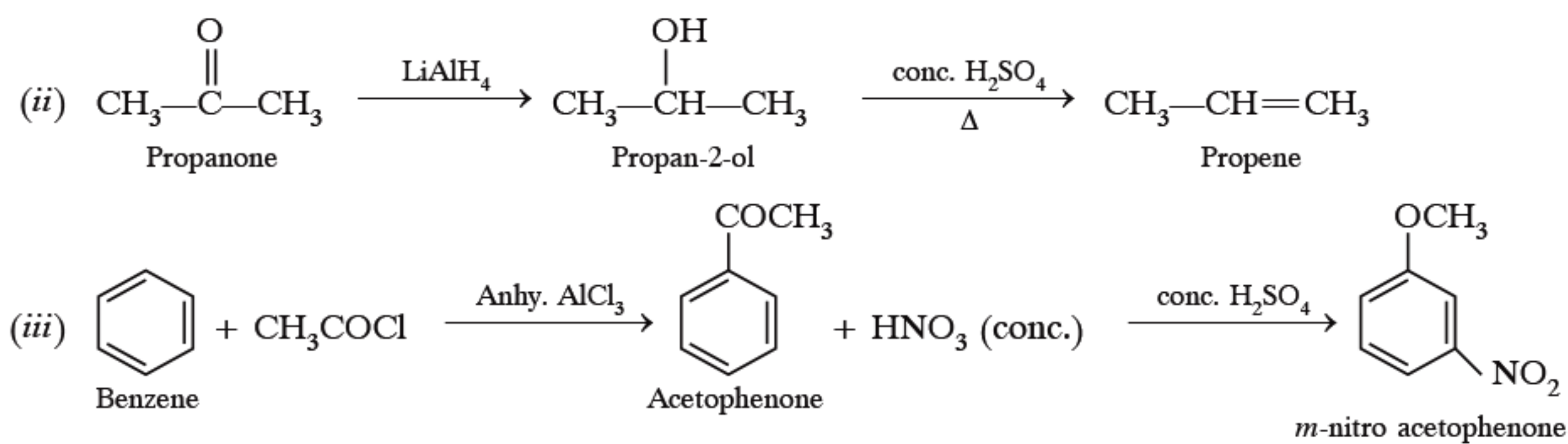






OR





35. (a) It is because  $\text{F}_2$  is strong oxidising agent, it has ability to form fluorides in higher oxidation state which has high lattice energy.
- (b)  $\text{Co}^{2+}$  because it has unpaired electrons, it is paramagnetic, attracted by magnetic field.
- (c) It is due to lanthanoid contraction which is due to poor shielding effect of *f*-electrons, hence, effective nuclear charge increases, hence, I.E. of *5d* is higher than *3d* and *4d* series.
- (d) Mn has broken crystal lattice, therefore, has lower melting point than Cr which forms strong metallic bond due to presence of unpaired electrons.
- (e) There is more frequent metal-metal bonding in case of heavy transition metals of *4d* and *5d* series as compared to *3d* series, hence they have higher melting points.



Time Allowed: 3 hours]

[Maximum Marks: 70

**General Instructions:**

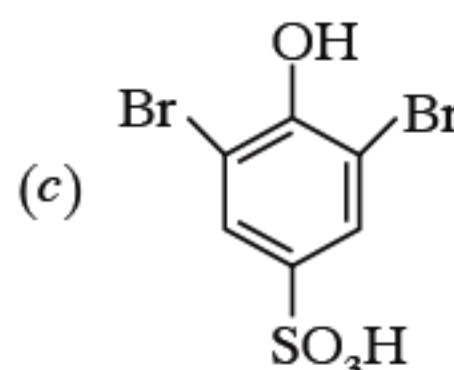
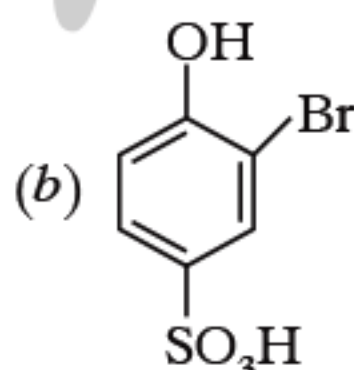
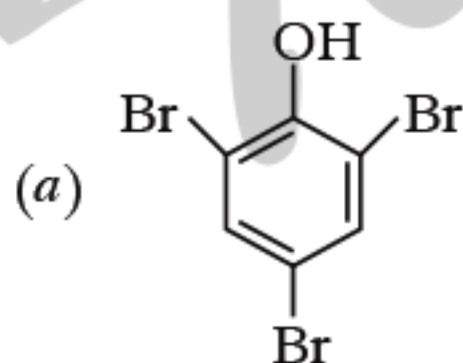
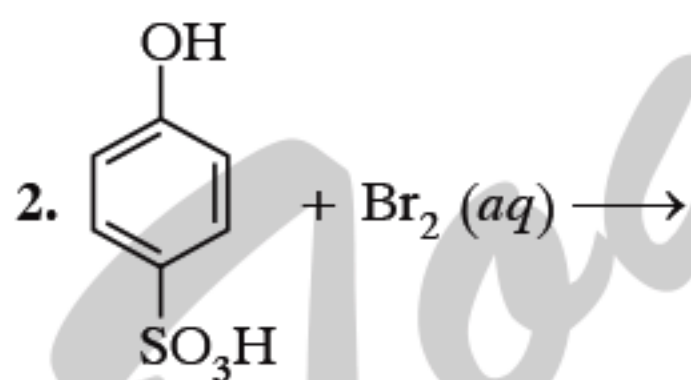
Read the following instructions carefully.

- There are 35 questions in this question paper with internal choice.
- Section A consists of 18 multiple-choice questions carrying 1 mark each.
- Section B consists of 7 very short answer questions carrying 2 marks each.
- Section C consists of 5 short answer questions carrying 3 marks each.
- Section D consists of 2 case-based questions carrying 4 marks each.
- Section E consists of 3 long answer questions carrying 5 marks each.
- All questions are compulsory.
- Use of log tables and calculators is not allowed.

**Section-A**

The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

- The carbohydrate present in liver, muscles and brain and its class is
  - Glucose, monosaccharide
  - Starch, polysaccharide
  - Glycogen, polysaccharide
  - Sucrose, disaccharide



(d) None of these

- Which of the following is blue in colour?
  - V<sup>3+</sup>
  - V<sup>2+</sup>
  - Cr<sup>3+</sup>
  - V<sup>4+</sup>
- Which of the following option will be  $\Lambda_m^\circ$  of CH<sub>3</sub>COONa if  $\Lambda_{\text{CH}_3\text{COOH}}^\circ$  is 390.5 S cm<sup>2</sup> mol<sup>-1</sup>, if  $\Lambda_{\text{H}^+}^\circ = 349.6$ ,  $\Lambda_{\text{Na}^+}^\circ = 50.5$ ,  $\Lambda_{\text{K}^+}^\circ = 73.5$   $\Lambda_{\text{OH}^-}^\circ = 199.1$  S cm<sup>2</sup> mol<sup>-1</sup>
  - 91 S cm<sup>2</sup> mol<sup>-1</sup>
  - 182 S cm<sup>2</sup> mol<sup>-1</sup>
  - 45.5 S cm<sup>2</sup> mol<sup>-1</sup>
  - 364 S cm<sup>2</sup> mol<sup>-1</sup>
- The half life of a first order reaction with 'k' value  $6.93 \times 10^{14} \text{ s}^{-1}$  is
  - $10^{-15} \text{ s}^{-1}$
  - $10^{15} \text{ s}$
  - $10^{-15} \text{ s}$
  - $10^{13} \text{ s}$

6. The rate of a gaseous reaction becomes half when the volume of vessel is doubled. The order of reaction is  
 (a) zero (b) 1 (c) 2 (d) 3
7. Benzamide on reaction with  $\text{Br}_2$  and aq. NaOH gives  
 (a) Aniline (b) Benzyl amine (c) Cyclo hexylamine (d) *p*-bromoaniline
8.  $[\text{Co}(\text{en})_3]_2(\text{SO}_4)_3$  has IUPAC name  
 (a) Tri (ethylene diamine) cobalt (III) sulphate (b) Tris-(ethane 1, 2-diamine) cobalt (III) sulphate  
 (c) Tris (ethylene diamine) cobalt (III) sulphate (d) None of these
9. 4 L of aqueous 0.02 M solution of NaCl was diluted by adding one litre of water. The molarity of resultant solution is  
 (a) 0.004 (b) 0.008 (c) 0.012 (d) 0.016
10. Aniline reacts with 2 moles of  $\text{CH}_3\text{I}$  to form  
 (a) N, N-Dimethyl aniline (b) N-Methyl aniline  
 (c) *p*-Toludine (d) *o*-Toludine
11. Write the correct IUPAC name of compound 'X' given below:  

$$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$$
 'X' is the  $\text{CH}_2$  group.  
 (a) 2-Oxopentanoic acid (b) 4-Formyl pentanoic acid  
 (c) 4-Oxopentanoic acid (d) 4-One pentanoic acid
12. Calculate the quantity of electricity in coulombs required to deposit all the silver metal from 2.50 mL of 1 M  $\text{AgNO}_3$  [Given:  $\text{Ag} = 108 \text{ g mol}^{-1}$ ,  $1 \text{ F} = 96500$ ]  
 (a) 241250 C (b) 24125 C (c) 893.5 C (d) 241.25 C
13. The spin only magnetic moment of  $[\text{MnBr}_4]^{2-}$  is 5.9 B.M. The geometry of complex ion is  
 (a)  $dsp^2$ , square planar (b)  $sp^3$ , square planar (c)  $sp^3$ , tetrahedral (d)  $dsp^2$ , tetrahedral
14. At T K, for the reaction  $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \longrightarrow 2\text{HI}(\text{g})$ .  
 $\frac{\Delta[\text{HI}]}{\Delta t}$  is found to be  $2 \times 10^{-4} \text{ mol L}^{-1} \text{ min}^{-1}$ . What is average rate of this reaction in  $\text{mol L}^{-1} \text{ min}^{-1}$ ?  
 (a)  $2 \times 10^{-4}$  (b)  $10^{-4}$  (c)  $4 \times 10^{-4}$  (d)  $8 \times 10^{-4}$

In the following questions (Q. No. 15 – 18), a statement of assertion followed by statement of a reason is given. Choose the correct answer out of the following choices.

- (a) Both A and R are true and R is the correct explanation of A.  
 (b) Both A and R are true but R is not the correct explanation of A.  
 (c) A is true but R is false.  
 (d) A is false but R is true.
15. Assertion (A): Glucose reacts with acetic anhydride to form glucose pentaacetate.  
 Reason (R): Glucose has 5—OH group which get acetylated on reaction with acetic anhydride.
16. Assertion (A): Benzyl bromide reacts with KCN to form benzyl cyanide.  
 Reason (R): Benzyl cyanide on reduction with  $\text{LiAlH}_4$  gives 2-phenyl ethanamine which on reaction with  $\text{HNO}_2$  gives 2-phenyl ethanol.
17. Assertion (A): Ditert. butyl ether cannot be prepared by Williamson synthesis.  
 Reason (R): Tert. butyl halide will undergo elimination faster than substitution, on reaction with sodium tert. butoxide.
18. Assertion (A):  $\text{Cr}_2\text{O}_7^{2-}$  (orange) changes to yellow in colour in basic medium.  
 Reason (R): Redox reaction takes place where  $\text{Cr}_2\text{O}_7^{2-}$  changes into  $\text{CrO}_4^{2-}$ .

### Section-B

This section contains 7 questions with internal choice in two questions. The following questions are very short answer type and carry 2 marks each.

19. A first order reaction takes 30 minutes for 20% decomposition.  
 Calculate  $t_{1/2}$  [ $\log 2 = 0.3010$ ,  $\log 5 = 0.6990$ ,  $\log 4 = 0.6021$ ]

20. Using IUPAC norms write the formula for the following:

(a) Tetrahydroxidozincate (II)

(b) Potassium trioxalatochromate (III)

OR

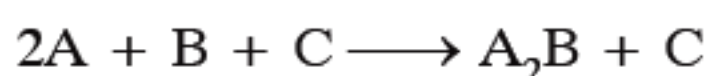
(a) Write electronic configuration of  $K_4[Mn(CN)_6]$ . (b) Give one example of hexadentate ligands.

21. Represent the cell in which the following reaction takes place:



Calculate its  $E_{cell}$  if  $E^\circ_{Cell} = 3.17 V$

22. For a reaction:



The rate =  $k[A][B]^2$  with  $k = 2 \times 10^{-6} L^2 mol^{-2} s^{-1}$ . Calculate the initial rate of reaction when  $[A] = 0.1 M$ ,  $[B] = 0.2 M$  and  $[C] = 0.8 M$ .

23. (a) Distinguish between the following compounds by suitable chemical tests.



(b) Convert 2-Bromopropane to Propan-1-ol.

24. (a) Which of the two components of starch is water soluble?

(b) What are biocatalysts? Give an example.

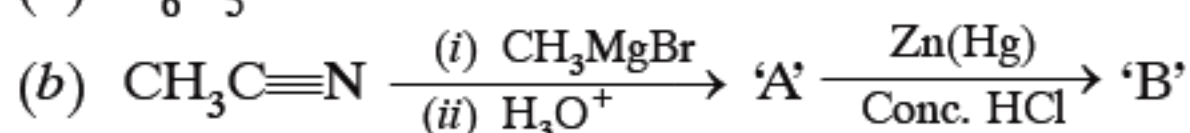
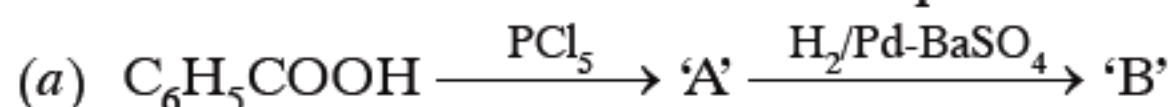
OR

Define the following terms:

(a) Nucleotide

(b) Essential amino acids

25. Write the structures of the main compounds 'A' and 'B' in each of the following reactions:



### Section-C

This section contains 5 questions with internal choice in two questions. The following questions are short answer type and carry 3 marks each.

26. (a) Name two purine bases in DNA.

(b) Name two pyrimidine bases in RNA.

(c) Which vitamin deficiency leads to loss of hair?

27. Two elements A and B form compounds having formula  $AB_2$  and  $AB_4$ . When dissolved in 20 g of  $C_6H_6$ , 1 g of  $AB_2$  lowers the freezing point by 2.3 K whereas 1.0 g of  $AB_4$  lowers it by 1.3 K. The molal depression constants for benzene is  $5.1 K kg mol^{-1}$ . Calculate atomic mass of A and B.

OR

The boiling point of benzene is 353.23 K. When 1.8 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of solute.  $K_b$  for benzene is  $2.53 K kg mol^{-1}$ .

28. (a) Explain the observed  $K_b$  order  $(C_2H_5)_2NH > (C_2H_5)_3N > C_2H_5NH_2$  in aqueous solution.

(b) How will you convert benzonitrile to acetophenone?

(c) How will you prepare *p*-nitroaniline from aniline?

29. Answer the following questions: (Any 3)

(a) Why is an increase in temperature observed on mixing chloroform and acetone?

(b) Why does sodium chloride solution freeze at a lower temperature than water?

(c) Why intravenous injection must be isotonic to body fluids?

(d) Why boiling point of sea water higher than river water?

30. (a) Predict the number of unpaired electrons in  $[Mn(H_2O)_6]^{2+}$ .

(b) Write the IUPAC name of  $[Co(NH_3)_5NO_2]Cl_2$ .

(c) Write the hybridisation and shape of  $[NiCl_4]^{2-}$ . [At No. of Mn = 25, Ni = 28]

### Section-D

The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

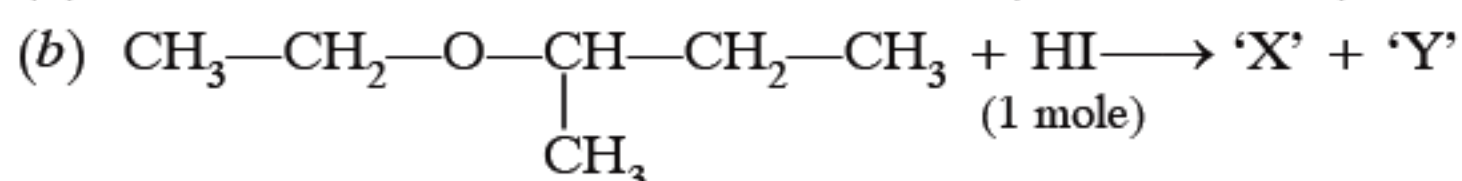
#### Epoxides

31. Epoxides or olefin oxides are also called cyclic ethers. Their structure contains a three membered ring made of two carbon and oxygen atom. They are heterocyclic compounds, highly reactive, e.g. they undergo reactions that are accompanied by ring opening and closing followed by attachment of the nucleophile. These reactions are used in production of hypertension medications, antibiotics and steroids.  $H_2O_2$  is most common oxidants in olefin epoxidation process,  $H_2O_2$  is rarely used because it poorly dissolves in hydrocarbons. The course of the process is catalysed by metal oxides of group 4–6, e.g. Ti, V, Mo, W. The well known is propene epoxidation reaction. Propene oxide production in the world is close to 6 million tons per year.

(Reference: International Journal of Molecular Sciences, (MDPI) P.3. Ins J. Mol. Sc. 2020-21, 5443.)

Answer the following questions:

(a) What happens when ethylene oxide (epoxy ethane) reacts with 2 moles of HI?



Identify 'X' and 'Y'.

(c) (i) Write all possible isomers of  $C_2H_4O$ .

(ii) Convert ethanol to diethyl ether.

OR

Write isomeric ethers with molecular formula  $C_4H_{10}O$ . What type of isomerism is shown by these ethers?

32. Observe the table in which physical data of Halomethane, polyhalogen derivative and haloarenes is given.

Table: Some Physical Data of Halomethanes ( $CH_3-X$ )

	Bond C—X length	Bond enthalpy	Dipole moment		
1.	$CH_3F$	139	452	1.847D	
2.	$CH_3Cl$	178	351	1.860D	
3.	$CH_3Br$	193	293	1.83D	
4.	$CH_3I$	214	234	1.636D	
5.	$CH_2Cl_2$	—	—	1.62D	
6.	$CHCl_3$	—	—	1.03D	
7.	$CCl_4$	—	—	Zero	
				<b>Dipole moment</b>	<b>Melting point</b>
8.	<i>p</i> -dichloro benzene			Zero	325K
9.	<i>o</i> -dichloro benzene			2.54D	216K
10.	<i>m</i> -dichloro benzene			1.72D	249K
				<b>Boiling point</b>	
11.	$C_6H_5F$			1.60D	358K
12.	$C_6H_5Cl$			1.69D	405K
13.	$C_6H_5Br$			1.70D	429K
14.	$C_6H_5I$			1.70D	462K

Answer the questions based on above table.

(a) Why does  $CH_3Cl$  has highest dipole moment among  $CH_3Cl$ ,  $CH_3F$ ,  $CH_3Br$  and  $CH_3I$ ?

(b) Why is dipole moment of *o*-dichlorobenzene higher than *p*-dichlorobenzene?

- (c) (i) Why is melting point of *p*-dichloro benzene higher than *o*- and *m*- isomers?  
(ii) Why is dipole moment of  $C_6H_5I$  higher than  $C_6H_5F$ ?

OR

- (i) Why is boiling point of  $C_6H_5I$  highest among haloarenes?  
(ii) Why is dipole moment of  $CH_2Cl_2$  higher than  $CCl_4$ ?

### Section-E

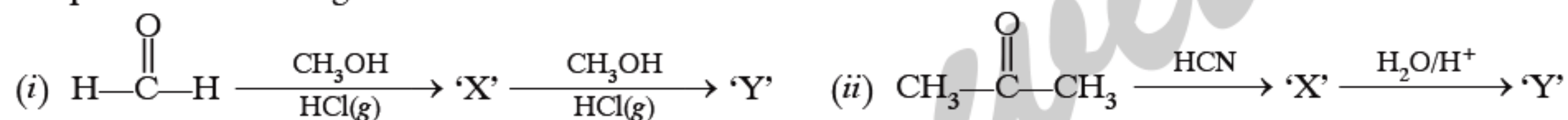
The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.

33. (a) Write the electronic configuration of  $Cr^{3+}$ .  
(b) Why is  $Fe^{3+}$  more stable than  $Fe^{2+}$ ?  
(c) Why is enthalpy of atomisation of transition metals high?  
(d) Why do transition metal form complex compounds in zero oxidation state?  
(e) Why is  $Cu^{2+}$  blue where as  $Zn^{2+}$  colourless?

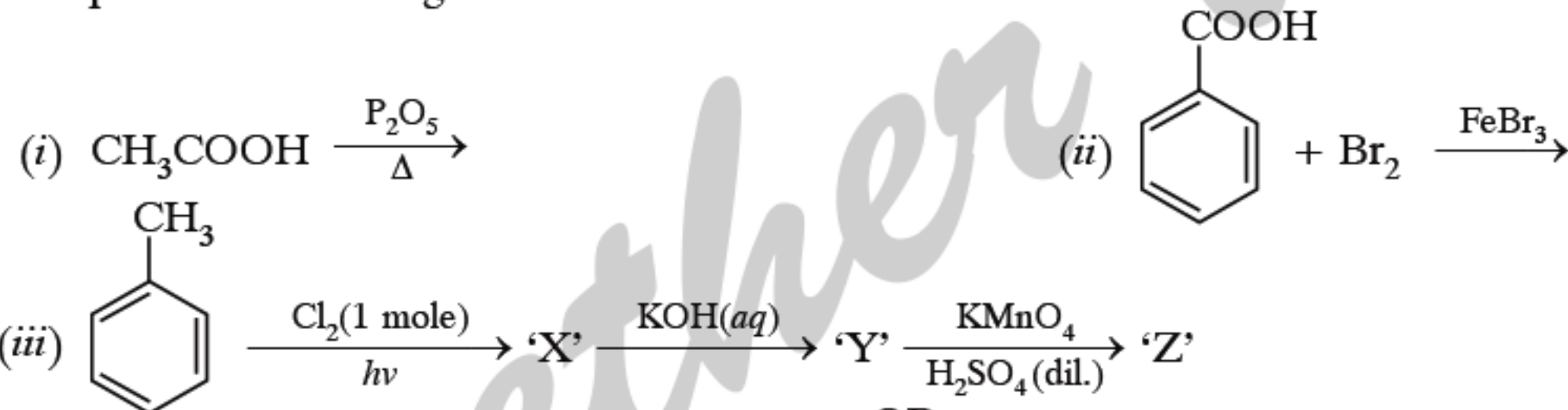
OR

- (a) (i) What are Actinoids?  
(ii) Why  $La(OH)_3$  is strongest base among hydroxide of lanthanoids.  
(iii) Why is 'Sc' largest in 3*d*-series?  
(b)  $Cu^+(aq) \longrightarrow$   
(c) Arrange  $VO_2^+$ ,  $MnO_4^-$ ,  $Cr_2O_7^{2-}$  in increasing order of oxidising power and give reason.

34. (a) Complete the following:



- (b) Complete the following reactions:



OR

- (a) How will you carry out the following conversions:  
(i) Benzaldehyde to 3-phenyl-1-propanol      (ii) Propanoic acid to propenoic acid.  
(iii) Benzoyl chloride to Benzonitrile.  
(b) Why do aldehydes undergo nucleophilic addition reaction more readily than ketones?  
(c) Why does benzoic acid not undergo Friedal Crafts reaction?
35. (a) Calculate the emf for the given cell at 25 °C:  
 $Cr | Cr^{3+} (0.1 M) || Fe^{2+} (0.01 M) | Fe$   
[Given:  $E_{Cr^{3+}/Cr}^\circ = -0.74 V$ ,  $E_{Fe^{2+}/Fe}^\circ = -0.44 V$ ]  
(b) Calculate the strength of the current required to deposit 1.2 g of magnesium from molten  $MgCl_2$  in 1 hour.  
[1 F = 96,500 C mol<sup>-1</sup>; Atomic mass: Mg = 24.0]

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