





SAMPLE QUESTION PAPERS CHEMISTRY

CBSE CLASS 12

ALL PAPERS STRICTLY ON REDUCED SYLLABUS AND
AS PER LATEST CBSE SAMPLE PAPER PROVIDED ON 9th OCT 2020

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TIME MANAGEMENT
CHART
+
IMPORTANT Q's
RELATED THEORY
+
2021
TOPPER TIP'S

A Complete Self-preparation, Class 12 Chemistry Sample Papers Book for 2021

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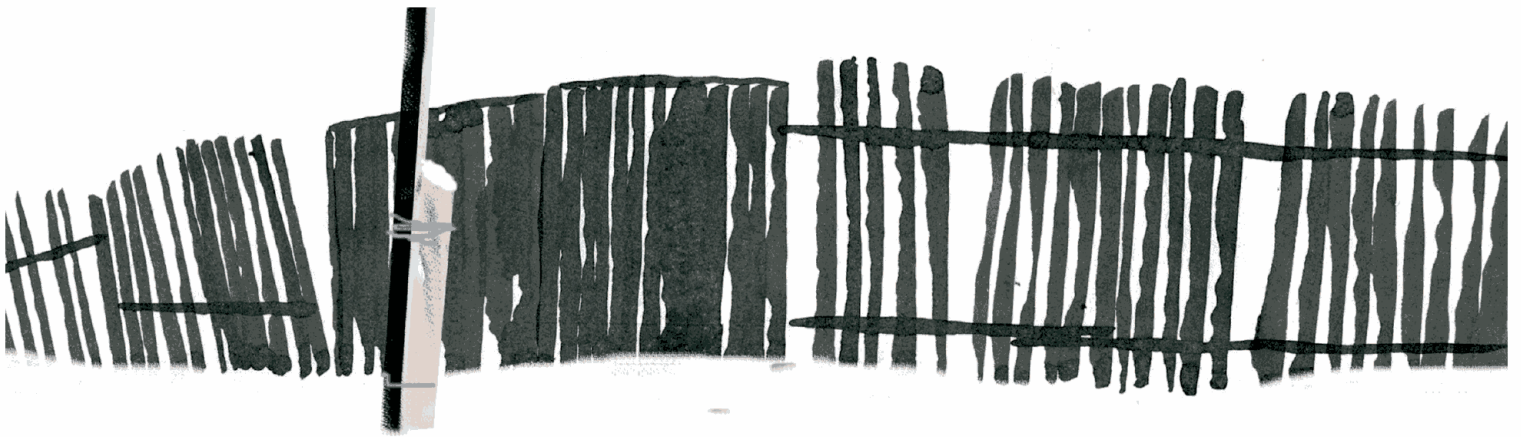
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AGP contributes **Rupee One** on every book purchased by you to the **Friends of Tribals Society** Organization for better education of tribal children.





Hello!

Friends, this year is all about keeping caution, strengthening determination and smart learning. CBSE has made sweeping changes in the paper pattern of all subjects and we at Educart have adhered 100% to those changes.

After the record breaking sales and acceptance of our sample papers last year pan-india, we have launched class 12 books with some critical value additions. This is our special self-prep version for 2021 with the new objective section included.

EduCart has also roped in CBSE Chemistry experts and most experienced teachers, to analyse the new pattern and prepare a fine XIIth Class Chemistry Sample Papers Book for 2021.

Go break a leg!



Reviews



★★★★★ **Read carefully what I am writing**

By Sathya Raji on 2 October, 2020



Guys, this is a very emotional review who has gone through a lot. I lost confidence because of the lack of interest in studies. Dad said focus only on studies but I only like TikTok and PUBG. Now both got banned and I had no other option but to study effectively as mid-terms were near. Now 4 months has passed and I had no preparation of boards at all. So I decided to change things and bought EDUCART.

Their maps (mind maps rather) for the first time in life helped me understand that what all comes in the chapters & what's important in those chapters. I was actually being able to study. I mean how can someone put so much effort in writing the book. So that definately helped me figure some topics well. Today, I finished 2 chapters of chemistry from Educart book and managed to make my father proud.



★★★★★ **Worth for 💰**

By Malika on 3 September, 2020



It's a very good book for the candidates appearing in 2021.... very nice explanation and also very nice editing 👍👍 Go for itt!!!!!!



5★ **Great product**

Student



I recommend this book.... magnificent book for revision...so many good questions are there... My God! the mind maps are super cool... A must buy book ...for class 10 students...just a little mistakes are there but it doesn't matter as those are check points of your learning Mustbuy 👍👍👍👍👍



★★★★★ **Wonderful book 😊**

By S S on 10 September, 2020



Every paper has CBSE questions written in neat way with explanations and related theory. My father purchased this book for me as i m weak in science but i am so happy with it that im posting the review myself to thank educart personally. Edcart, please continue to make such books, in this covid time, this book is what we needed really!



Dear Sir 🗣️

6.77M Subscribers



India ki pehli atma-nirbhar self prep book that really no publisher can match with. Educart question bank is a must buy for all students!



T S Sudhir

(Author of Saina Nehwal's Biography | Journalist | Educator)

To: quickreply@agpgroup.in



Educart Exemplar is my suggested book for this year and I rarely recommend books. This one I have thoroughly read and liked for my students.



RC Chauhan

HOD of Mathematics - DPS

To: quickreply@agpgroup.in



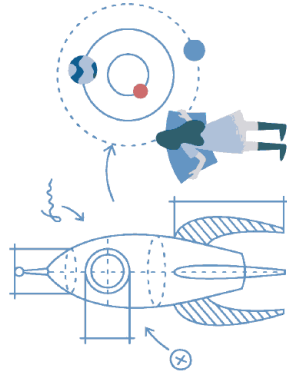
We have reviewed countless Xth Class Maths books but Educart's Sample papers is our top recommendation. Educart has done their homework well on how CBSE students nowadays want to learn solving of maths standard questions.



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* Self-assessment papers' solution are available on our website (www.educart.net).



Question Paper Design

Sections ↓	OBJECTIVE				SUBJECTIVE		
	Case-based	MCQ	Assertion Reason (A-R)	SA I	SA II	LA	
	4m each	1m each	1m each	2m each	3m each	5m each	
Section A	1Q (4 MCQ) + 1Q (4 A-R) (1 choice per Q)	9Q (4 choice)	5Q (1 choice)	-	-	-	
Section B	-	-	-	9Q (3 choice)	-	-	
Section C	-	-	-	-	5Q (2 choice)	-	
Section D	-	-	-	-	-	3Q (3 choice)	
Total Marks	2Q (8m)	9Q (9m)	5Q (5m)	9Q (18m)	5Q (15m)	3Q (15m)	

(vi)

Note: This blueprint is prepared for simplicity purpose, based on the CBSE Sample Paper provided on 9th October 2020.



Time Management

The 3 hour long board paper needs to be attempted strategically so that you are not cut short for time on any question at the end. This means you need to complete each section of the paper within a pre-defined duration. Our experts have figured out the optimum time duration for each section for you to keep in mind. Please see below the time management chart for all subjects:

CHEMISTRY				
Sections	Question Type	Questions	Time To Be Spent (Per Question)	Total Time
Section A	Case-based	1Q → 4 MCQ (4m) 1Q → 4 A-R (4m)	1.5 min per MCQ 2.5 min per A-R 8 min reading (passage)	$1.5 \times 4 + 2.5 \times 4 + 8$ = 24 min
	MCQ	9Q (1m each)	1.5 min per MCQ	$1.5 \times 9 \approx$ 14 min
	Assertion Reason (A-R)	5Q (1m each)	2.5 min per A-R	$2.5 \times 5 \approx$ 12 min
Section B	SA I	9Q (2m each)	4 min per question	$4 \times 9 = 36$ min ≈ 35 min
Section C	SA II	5Q (3m each)	7 min per question	$7 \times 5 =$ 35 min
Section D	LA	3Q (5m each)	12 min per question	$12 \times 3 = 36$ min ≈ 35 min
				Total Time: 2 hours 35 min
				Revision Time: 25 min



Topper Tips

(on cracking new pattern)

Friends, on request of the Educart team, followed below are some points I've prepared for you to keep in mind whilst attempting the Class 12 Board Exams on the new pattern:

Give extra focus on Name/product Reactions, and Numericals

For the subjective section questions, it is advisable to focus on the below things:

- Practice as many numericals as you can (especially from 'Electrochemistry')
- Practice the product, properties, and anomalous behavior in 'p-Block Element' chapter from Inorganic Chemistry
- Focus on IUPAC nomenclature and name reactions from Organic Chemistry
- Pay extra attention to Name reactions like Wolff-Kishner, Clemmensen reduction, Williamson and Hell-Volhard-Zelinsky types.

All of this is given for quick revision in the objective section maps of this book next to help you further.

Select your MCQ options wisely (Hindi and English Core)

50% paper is now MCQs based. Do not rush into choosing a particular option. If unable to find the answer; use the rule of elimination to reach the most appropriate answer. Usually ruling out other 3 options works out faster.

Cracking Case-based Questions

Here is the trick. CBSE cannot ask any MCQ in case-based questions that is going to take you more than 1-2 minutes to solve as it will be a 1m MCQ each. So don't worry about the length of the question, treat it like a normal value input or understanding or remembering based question and move ahead. Time is of the essence.

New Pattern MCQs (English)

CBSE has made a complete overhaul of MCO's style of questioning in Reading and Literature comprehensions of English Section A. They are not direct but inference based and analytical thinking driven. Educart has provided detailed explanations in this book for such MCQs to help understand how to come to a conclusive option.

15 minutes reading time hack

- There is 30-50% internal choice this time in each section. You get good 15 minutes in the beginning to read the question paper. Use this time to mark the choice questions you are more confident in attempting to avoid wasting critical thinking time while writing the exam.
- Mark the tough questions you definitely don't know the answer to or where you feel you will struggle, and remember to leave space to come back to answering them.

Prioritise your Sections order

Decide which Section you would want to attempt first and which Section at last. Always attempt the easy questions first. This way your confidence will grow and you will be mentally ready to take on the more challenging questions.

Answers Structure has to be right

- Write most of the answers in bullet points (with headings) or in a tabular form where possible to save time and stick to the point. CBSE paper checkers prefer such format to make it easy to allot full marks.
- Underline key (value) points for all answers and follow word count to save on time.
- Explain lengthy answers with examples and diagrams.
- Recheck for all logics and calculations in case of numerical.



Syllabus

(Reduced)

Units	Unit Name	Marks
I	Solid State	23
II	Solutions	
III	Electrochemistry	
IV	Chemical Kinetics	
V	Surface Chemistry	
VII	p -Block Elements	19
VIII	d -and f -Block Elements	
IX	Coordination Compounds	
X	Haloalkanes and Haloarenes	28
XI	Alcohols, Phenols and Ethers	
XII	Aldehydes, Ketones and Carboxylic Acids	
XIII	Amines	
XIV	Biomolecules	
TOTAL		70
Practicals (Volumetric Analysis 8m + Salt Analysis 8m + Experiments 6m + Project 4m + Viva 4m)		30

Unit I: Solid State

Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea). Unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell, packing in solids, packing efficiency, voids, number of atoms per unit cell in a cubic unit cell, point defects.

Unit II: Solutions

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, Raoult's law, colligative properties - relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties.

Unit III: Electrochemistry

Redox reactions, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and EMF of a cell, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis.

Unit IV: Chemical Kinetics

Rate of a reaction (Average and instantaneous), factors affecting rate of reaction: concentration, temperature, catalyst; order and molecularity of a reaction, rate law and specific rate constant, integrated rate equations and half-life (only for zero and first order reactions).

Unit V: Surface Chemistry

Adsorption - physisorption and chemisorption, factors affecting adsorption of gases on solids, colloidal state: distinction between true solutions, colloids and suspension; lyophilic, lyophobic, multi-molecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation.

Unit VII: p-Block Elements

Group -15 Elements: General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; Nitrogen preparation properties and uses; compounds of Nitrogen: preparation and properties of Ammonia and Nitric Acid.

Group 16 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties, dioxygen: preparation, properties and uses, classification of Oxides, Ozone, Sulphur -allotropic forms; compounds of Sulphur: preparation properties and uses of Sulphur-dioxide, Sulphuric Acid: properties and uses; Oxoacids of Sulphur (Structures only).

Group 17 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens, Preparation, properties and uses of Chlorine and Hydrochloric acid, interhalogen compounds, Oxoacids of halogens (structures only).

Group 18 Elements: General introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses..

Unit VIII: d and f Block Elements

General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals – metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation.

Lanthanoids - Electronic configuration, oxidation states and lanthanoid contraction and its consequences.

Unit IX: Coordination Compounds

Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner's theory, VBT, and CFT.

Unit X: Haloalkanes and Haloarenes

Haloalkanes: Nomenclature, nature of C–X bond, physical and chemical properties, optical rotation mechanism of substitution reactions.

Haloarenes: Nature of C–X bond, substitution reactions (Directive influence of halogen in monosubstituted compounds only).

Unit XI: Alcohols, Phenols and Ethers

Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration.

Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenols.

Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses.

Unit XII: Aldehydes, Ketones and Carboxylic Acids

Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes, uses.

Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

Unit XIII: Amines

Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

Unit XIV: Biomolecules

Carbohydrates - Classification (aldoses and ketoses), monosaccharides (glucose and fructose), D-L configuration

Proteins - Elementary idea of - amino acids, peptide bond, polypeptides, proteins, structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins.

Nucleic Acids: DNA and RNA.

Deleted

(For 2021 Exam)

Unit I: Solid State

Electrical and magnetic properties. Band theory of metals, conductors, semiconductors and insulators and n and p type semi conductors.

Unit II: Solutions

Abnormal molecular mass, Van't Hoff factor

Unit III: Electrochemistry

Lead accumulator, fuel cells, corrosion, law of electrolysis (elementary idea), dry cell- electrolytic cells and Galvanic cells

Unit IV: Chemical Kinetics

Concept of collision theory (elementary idea, no mathematical treatment), activation energy, Arrhenius equation.

Unit V: Surface Chemistry

emulsion - types of emulsions, catalysis: homogenous and heterogeneous, activity and selectivity of solid catalysts; enzyme catalysis

Unit VI: General Principles and Processes of Isolation of Elements (Entire unit)

Unit VII: p-Block Elements

Preparation and properties of Phosphine, Sulphuric Acid: industrial process of manufacture, Oxides of Nitrogen (Structure only); Phosphorus - allotropic forms, compounds of Phosphorus: Preparation and properties of Halides and Oxo acids (elementary idea only).

Unit VIII: d and f Block Elements

Chemical reactivity of lanthanoids, Actinoids -Electronic configuration, oxidation states and comparison with lanthanoids. Preparation and properties of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$

Unit IX: Coordination Compounds

Structure and stereoisomerism, importance of coordination compounds (in qualitative analysis, extraction of metals and biological system).

Unit X: Haloalkanes and Haloarenes

Uses and environmental effects of -dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

Unit XI: Alcohols, Phenols and Ethers

uses with special reference to methanol and ethanol.

Unit XIII: Amines

Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

Unit XIV: Biomolecules

Oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen), importance of carbohydrates.

Vitamins- classification and functions. Enzymes. Hormones - Elementary idea excluding structure.

Unit XV: Polymers (Entire unit)

Unit XVI: Chemistry in Everyday life (Entire unit)



FAQs

1. Can we use black pen in CBSE board exam 2021?

As per last year's CBSE guideline, students appearing for CBSE Board Exams can write answers ONLY with a Blue color pen (blue or royal blue). It should be a ball point, gel or fountain pen.

If the students want to use a black pen to highlight or bold the points in answers or for writing titles or headlines then it is allowed.

2. Will the CBSE 2021 paper on reduced syllabus come based on the sample paper CBSE released? Will the difficulty level be the same?

Yes, it will be exactly as per the paper pattern and type of questions introduced by CBSE in the 9th October 2020 uploaded Sample paper. As far as the difficulty level is concerned, expect an easier paper than the provided sample paper as CBSE will not want to reduce chances of students to pass considering COVID-19 has made things a bit difficult. However, this Educart book is prepared keeping a medium difficulty level to prepare students fully for the upcoming new pattern paper.

3. When will CBSE provide datesheet for 2021 boards?

Exact dates for all subjects' exams is usually provided in the month of December of the ongoing academic session. Last year it came on 16th December 2019. Expect the same in the month of December and expect the exams start date to be later than March for the 2020-21 session.

4. How shall I prepare when there is not much time left?

When in shortage of time, less material to study from, is better. This can be done by focusing on only NCERT books (for theory) and our Educart sample papers for practice and nothing else. Educart Sample papers book is 100% designed on the upcoming 2021 paper to help you cover questions on all possible topics with detailed explanations.

5. What is the Pass Marks Cut-off and Criteria?

A candidate has to obtain a grade higher than E (i.e. atleast 33% marks) in all the five subjects of external examination in the main or at the compartmental examinations.

6. How do I access latest CBSE circulars and announcements?

You can always email us on quickreply@agpgroup.in for any update you want. As far as official source is concerned, refer: www.cbseacademic.nic.in/circulars.html.

7. What is the process of applying for a recheck of Marks in a particular subject?

Any student has the right to do so within a week from date of declaration of CBSE board exam result.

The whole process of verification of marks is done online. Steps to apply for verification/rechecking of the answer sheet, are as follows: Apply for rechecking of marks on the CBSE's website www.cbse.nic.in by filling in your details and paying Rs. 500 per subject online (only). The result of verification of marks will be uploaded on the website automatically.

Overall, the verification will be restricted to checking whether all the answers have been checked, there has been no mistake in totalling of marks for each question and the marks have been transferred correctly on the title page of the answer book. A candidate may also apply for obtaining a copy of the evaluated answer book(s) at a later stage if not satisfied with the evaluation

8. What is the best way to practice from this book to score good marks?

In order to crack the board exam, this book is custom made to start with Topper Tips and Time management. This includes an explanation of how to smartly structure your 3 hours during the paper.

Once, you have covered the basics, you can go through the exclusive CBSE last year Topper hand-written solutions and CBSE papers to get a feel of what is normally asked and how to answer them.

Then you start with our most likely 6 solved sample papers, where you time yourself to complete each paper and cross-check your performance with our detailed solutions.

Lastly, the unsolved papers help you self-assess without the temptation of looking at the back and fine-tune your preparation. These are solid papers that, if done well will fully prepare you to do well in the 2021 board exam.

9. Who should I reach out to for any issue related to examination, re-evaluation of copy or any serious matter?

Ideally your only point of contact should be your school and they will take action on your behalf by submitting a request to CBSE regional office. However, we have managed to source some useful contacts in CBSE. Please [refer to the next page](#) for more information.



IMPORTANT CBSE CONTACTS

Lots of students and parents face the problem of not knowing how best to contact CBSE for matters related to *Examination, admission fees, last-minute change of subject, direct admissions, passing criteria, examination centre related issue, unfair means or even re-evaluation of results* if not satisfactory. This list is not exhaustive.

We have compiled a comprehensive list of contacts of your nearest CBSE Regional Offices for various issues depending on the region you belong to. CBSE prefers any request to be sent to Regional Offices only and that also via the head of your school ideally. It is, therefore, advised to make the request accordingly through a proper channel for prompt and timely action.

Your School Location/Region	CBSE Regional Office (RO) Contact Details
General	Dr. Sanyam Bhardwaj (Controller of Examinations) sanyamb.cbse@nic.in 011-22515828 Dr. Joseph Emmanuel (Director (Academics)) directoracad.cbse.nic.in 011-23212603
Delhi, Foreign Schools	CBSE, PS-1-2, Institutional Area, I.P. Extn, Patparganj, Delhi - 110092 rodelhi.cbse@nic.in 91-11-22239177-80, 22235948, 22235904
Uttar Pradesh, Uttarakhand	CBSE, 35 B, Civil Station, M.G. Marg, Civil Lines, Allahabad - 211001 roallahabad.cbse@nic.in 91-532-2407970-72
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Rajasthan, Gujarat, M.P., Dadra and Nagar Haveli	CBSE, Todarmal Marg, Ajmer - 305001 rojmer.cbse@nic.in 91-145-2627460
Bihar and Jharkhand	CBSE, Ambika Complex, Behind State Bank Colony, Near Brahmsthan, Sheikhpura, Raza Bazar, Bailey Road, Patna-800014 ropatna.cbse@nic.in 91-612-2295048, 2295080
West Bengal, Orissa, Chhattisgarh	CBSE, 6 th Floor, Alok Bharti Complex, Shaheed Nagar, Bhubaneswar-751007 robhubaneshwa.cbse@nic.in 91-674-2542312

CBSE

SAMPLE PAPER

9th October 2020

CHEMISTRY

Time Allowed: 3 Hours

Maximum Marks: 70

General Instructions:

Read the following instructions carefully.

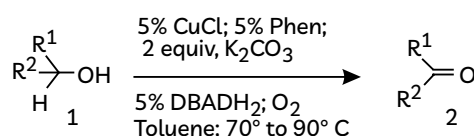
- There are 33 questions in this question paper. All questions are compulsory.
- Section A** – question no. **1** to **2** are case-based questions have four MCQs or Reason Assertion Type based on the given passage each carrying 1 mark.
- Section A** – Question **3** to **16** are MCQs and Reason Assertion type questions carrying 1 mark each.
- Section B** – question no. **17** to **25** are short answer type questions carrying 2 marks each.
- Section C** – question no. **26** to **30** are short answer type questions carrying 3 marks each.
- Section D** – question no. **31** to **33** are long answer type questions carrying 5 marks each.
- There is no overall choice in the question paper. However, internal choice have been provided.
- Use of calculators and log tables is **not** permitted.

SECTION - A

22 marks

1. Read the passage given below and answer the following questions:

An efficient, aerobic catalytic system for the transformation of alcohols into carbonyl compounds under mild conditions, copper-based catalyst has been discovered. This copper-based catalytic system utilizes oxygen or air as the ultimate, stoichiometric oxidant, producing water as the only by-product.



A wide range of primary, secondary, allylic, and benzylic alcohols can be smoothly oxidized to the corresponding aldehydes or ketones in good to excellent yields. Air can be conveniently used instead of oxygen without affecting the efficiency of the process. However, the use of air requires slightly longer reaction times.

This process is not only economically viable and applicable to large-scale reactions, but it is also environmentally friendly.

(Reference: Ohkuma, T., Ooka, H., Ikariya, T., & Noyori, R. (1995). Preferential hydrogenation of aldehydes and ketones. *Journal of the American Chemical Society*, 117(41), 10417-10418.)

The following questions are multiple choice questions. Choose the most appropriate answer:

$$1 \times 4 = 4$$

- (A) The Copper based catalyst mention in the study above can be used to convert:
- (a) propanol to propanonic acid (b) propanone to propanoic acid
(c) propanone to propan-2-ol (d) propan-2-ol to propanone
- (B) The carbonyl compound formed when ethanol gets oxidised using this copper-based catalyst can also be obtained by ozonolysis of:
- (a) But-1-ene (b) But-2-ene
(c) Ethene (d) Pent-1-ene

OR

Which of the following is a secondary allylic alcohol?

- (a) But-3-en-2-ol (b) But-2-en-2-ol
(c) Prop-2-enol (d) Butan-2-ol
- (C) Benzyl alcohol on treatment with this copper-based catalyst gives a compound 'A' which on reaction with KOH gives compounds 'B' and 'C'. Compound 'B' on oxidation with KMnO_4 . KOH gives compound 'C'. Compounds 'A', 'B' and 'C' respectively are :
- (a) Benzaldehyde, Benzyl alcohol, potassium salt of Benzoic acid
(b) Benzaldehyde, potassium salt of Benzoic acid, Benzyl alcohol
(c) Benzaldehyde, Benzoic acid, Benzyl alcohol
(d) Benzoic acid, Benzyl alcohol, Benzaldehyde
- (D) An organic compound 'X' with molecular formula $\text{C}_3\text{H}_8\text{O}$ on reaction with this copper based catalyst gives compound 'Y' which reduces Tollen's reagent. 'X' on reaction with sodium metal gives 'Z' . What is the product of reaction of 'Z' with 2-chloro-2-methylpropane?
- (a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OC}(\text{CH}_3)_3$ (b) $\text{CH}_3\text{CH}_2\text{OC}(\text{CH}_3)_3$
(c) $\text{CH}_2=\text{C}(\text{CH}_3)_2$ (d) $\text{CH}_3\text{CH}_2\text{CH}=\text{C}(\text{CH}_3)_2$

2. Read the passage given below and answer the following questions:

The amount of moisture that leather adsorbs or loses is determined by temperature, relative humidity, degree of porosity, and the size of the pores. Moisture has great practical significance because its amount affects the durability of leather, and in articles such as shoes, gloves, and other garments, the comfort of the wearer. High moisture content accelerates deterioration and promotes mildew action. On the other hand, a minimum amount of moisture is required to keep leather properly lubricated and thus prevent cracking.

The study indicates that adsorption of moisture by leather is a multi-molecular process and is accompanied by low enthalpies of adsorption. Further 75-percent relative humidity the adsorption is a function of surface area alone. Untanned hide and chrome-tanned leathers have the largest surface areas. The leathers tanned with the vegetable tanning materials have smaller surface areas since they are composed of less hide substance and the capillaries are reduced to smaller diameters, in some cases probably completely filled by tanning materials. This process of tanning occurs due to mutual coagulation of positively charged hide with negatively charged tanning material. The result of the study indicated that untanned hide and chrome-tanned leather adsorb the most water vapour.

(Source: Kanagy, J. R. (1947). Adsorption of water vapor by untanned hide and various leathers at 100 F. *Journal of Research of the National Bureau of Standards*, 38(1), 119-128.)



In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices:

$$1 \times 4 = 4$$

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- (c) Assertion is correct statement but reason is wrong statement.
- (d) Assertion is wrong statement but reason is correct statement.
- (A) **Assertion:** Vegetable tanned leather cannot adsorb a large amount of moisture.
Reason: Porous materials have higher surface area.
- (B) **Assertion:** Animal hide soaked in tannin results in hardening of leather.
Reason: Tanning occurs due to mutual coagulation.
- (C) **Assertion:** Adsorption of moisture by leather is physisorption.
Reason: It is a multimolecular process and is accompanied by low enthalpies of adsorption.
- (D) **Assertion:** The vegetable tanning materials have smaller surface areas.
Reason: The capillaries present in leather are reduced to smaller diameters.

OR

Assertion: Leather absorbs different amount of moisture.

Reason: Some moisture is necessary to prevent cracking of leather.

Following questions (Q. No. 3 - 11) are Multiple Choice Questions carrying 1 mark each:

3. Which of the following options will be the limiting molar conductivity of CH_3COOH if the limiting molar conductivity of CH_3COONa is $91 \text{ Scm}^2\text{mol}^{-1}$? Limiting molar conductivity for individual ions are given in the following table:

S.No	Ions	limiting molar conductivity / $\text{Scm}^2\text{mol}^{-1}$
1	H^+	349.6
2	Na^+	50.1
3	K^+	73.5
4	OH^-	199.1

- (a) $350 \text{ Scm}^2\text{mol}^{-1}$ (b) $375.3 \text{ Scm}^2\text{mol}^{-1}$
(c) $390.5 \text{ Scm}^2\text{mol}^{-1}$ (d) $340.4 \text{ Scm}^2\text{mol}^{-1}$

1

4. Curdling of milk is an example of:

- (a) breaking of peptide linkage (b) hydrolysis of lactose
(c) breaking of protein into amino acids (d) denaturation of protein

OR

Dissachrides that are reducing in nature are:

- (a) sucrose and lactose (b) sucrose and maltose
(c) lactose and maltose (d) sucrose, lactose and maltose

1

5. When 1 mole of benzene is mixed with 1 mole of toluene The vapour will contain: (Given: vapour of benzene = 12.8kPa and vapour pressure of toluene = 3.85 kPa).

- (a) equal amount of benzene and toluene as it forms an ideal solution
(b) unequal amount of benzene and toluene as it forms a non ideal solution
(c) higher percentage of benzene
(d) higher percentage of toluene

1

6. Which of the following is the reason for Zinc not exhibiting variable oxidation state
- (a) inert pair effect (b) completely filled 3d subshell
 (c) completely filled 4s subshell (d) common ion effect

OR

Which of the following is a diamagnetic ion: (Atomic numbers of Sc, V, Mn and Cu are 21, 23, 25 and 29 respectively)

- (a) V^{2+} (b) Sc^{3+}
 (c) Cu^{2+} (d) Mn^{3+} 1

7. Propanamide on reaction with bromine in aqueous NaOH gives:
- (a) Propanamine (b) Etanamine
 (c) N-Methyl ethanamine (d) Propanenitrile

OR

IUPAC name of product formed by reaction of methyl amine with two moles of ethyl chloride

- (a) N, N-Dimethylethanamine
 (b) N, N-Diethylmethanamine
 (c) N-Methyl ethanamine
 (d) N-Ethyl, N-methylethanamine 1

8. Ambidentate ligands like NO_2^- and SCN^- are :

- (a) unidentate (b) didentate
 (c) polydentate (d) has variable denticity

OR

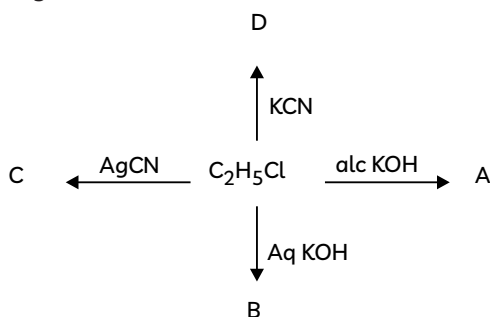
The formula of the coordination compound Tetraammineaquachloridocobalt(III) chloride is

- (a) $[Co(NH_3)_4(H_2O)Cl]Cl_2$
 (b) $[Co(NH_3)_4(H_2O)Cl]Cl_3$
 (c) $[Co(NH_3)_2(H_2O)Cl]Cl_2$
 (d) $[Co(NH_3)_4(H_2O)Cl]Cl$ 1

9. 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) Sc^{3+} , Ti^{4+} , Mn^{3+}
 (b) Sc^{3+} , Zn^{2+} , Ni^{2+}
 (c) V^{3+} , V^{2+} , Fe^{3+}
 (d) Ti^{3+} , Ti^{4+} , Ni^{2+} 1

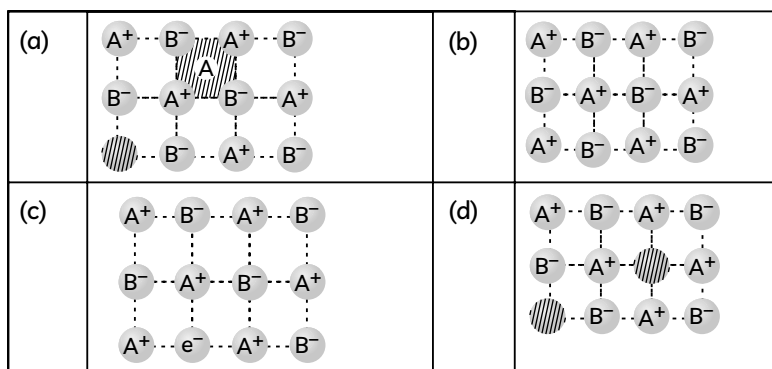
10. Identify A, B, C and D:



- (a) A = C_2H_4 , B = C_2H_5OH , C = C_2H_5NC , D = C_2H_5CN
 (b) A = C_2H_5OH , B = C_2H_4 , C = C_2H_5CN , D = C_2H_5NC
 (c) A = C_2H_4 , B = C_2H_5OH , C = C_2H_5CN , D = C_2H_5NC
 (d) A = C_2H_5OH , B = C_2H_4 , C = C_2H_5NC , D = C_2H_5CN 1



11. The crystal showing Frenkel defect is:



1

In the following questions, (Q.No. 12 - 16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices:

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
 (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
 (c) Assertion is correct statement but reason is wrong statement.
 (d) Assertion is wrong statement but reason is correct statement.

12. **Assertion:** The two strands are complementary to each other.

Reason: The hydrogen bonds are formed between specific pairs of bases.

1

13. **Assertion:** Ozone is thermodynamically stable with respect to oxygen.

Reason: Decomposition of ozone into oxygen results in the liberation of heat

1

14. **Assertion:** Aquatic species are more comfortable in cold waters rather than in warm waters.

Reason: Different gases have different K_H values at the same temperature

OR

Assertion: Nitric acid and water form maximum boiling azeotrope.

Reason: Azeotropes are binary mixtures having the same composition in liquid and vapour phase.

1

15. **Assertion:** Carboxylic acids are more acidic than phenols.

Reason: Phenols are ortho and para directing.

1

16. **Assertion:** Methoxy ethane reacts with HI to give ethanol and iodomethane.

Reason: Reaction of ether with HI follows S_N2 mechanism.

1

SECTION - B

18 marks

The following questions, (Q.No. 17 - 25) are Short Answer Type I Questions (SA-I) and carrying 2 marks each:

17. 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:

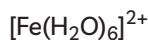
(A) Aniline to chlorobenzene

(B) 2-bromopropane to 1-bromopropane

2

18. A glucose solution which boils at 101.04°C at 1 atm. What will be relative lowering of vapour pressure of an aqueous solution of urea which is equimolal to given glucose solution? (Given: K_b for water is 0.52 K kg mol⁻¹) 2

19. (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: $[\text{CoCl}_2(\text{en})_2]\text{NO}_3$

OR

(A) Predict the geometry of $[\text{NiCN}_4]^{2-}$.

(B) Calculate the spin only magnetic moment of $[\text{Cu}(\text{NH}_3)_4]^{2+}$ ion. 2

20. For a reaction the rate law expression is represented as follows:

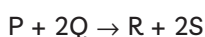
$$\text{Rate} = k [\text{A}][\text{B}]^{1/2}$$

(A) Interpret whether the reaction is elementary or complex. Give reason to support your answer.

(B) Write the units of rate constant for this reaction if concentration of A and B is expressed in moles/L.

OR

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

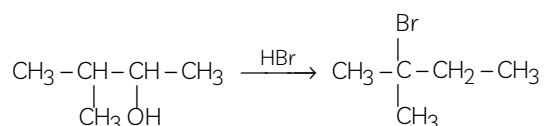


Exp.	Initial P(mol/L)	Initial Q (mol/L)	Init. Rate of Formation of R (M min ⁻¹)
1	0.10	0.10	3.0×10^{-4}
2	0.30	0.30	9.0×10^{-4}
3	0.10	0.30	3.0×10^{-4}
4	0.20	0.40	6.0×10^{-4}

Determine the rate law expression for the reaction. 2

21. 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) 2

22. When 3-methylbutan-2-ol is treated with HBr, the following reaction takes place:



Give a mechanism for this reaction. 2

23. Give the formula and describe the structure of a noble gas species which is isostructural with IF_5^- . 2

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

(1) 1- Chlorobutane

(2) 2-chloro-2-methylpropane

Which of the above is most likely to give (A) an inverted product (B) a racemic mixture:

Justify your answer. 2

25. Atoms of element P form *ccp* lattice and those of the element Q occupy 1/3rd of tetrahedral voids and all octahedral voids. What is the formula of the compound formed by the elements P and Q?

2

SECTION - C

15 marks

Q. No 26 - 30 are Short Answer Type II Questions (SA-II) and carrying 3 marks each:

26. Give reasons for the following:

- Transition elements act as catalysts
- It is difficult to obtain oxidation state greater than two for Copper.
- CrO is basic but Cr₂O₃ is amphoteric.

OR

Observed and calculated values for the standard electrode potentials of elements from Ti to Zn in the first reactivity series are depicted in figure (1):

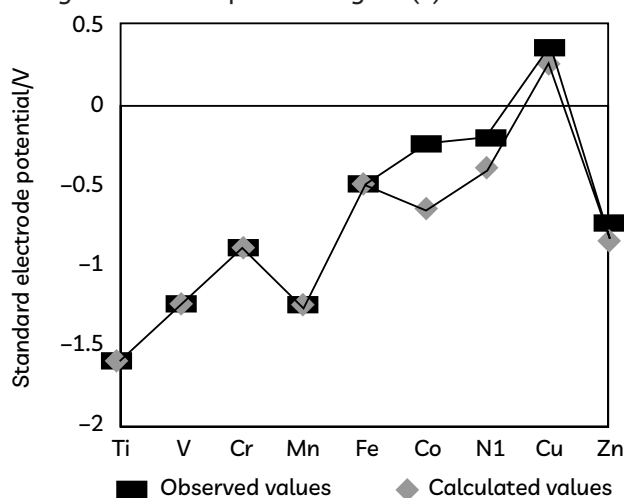


FIGURE 1

Explain the following observations:

- The general trend towards less negative E° values across the series
- The unique behaviour of Copper
- More negative E° values of Mn and Zn

3

27. Arrange the following in increasing order of property specified:

- Aniline, ethanamine, 2-ethylethanamine (solubility in water)
- Ethanoic acid, ethanamine, ethanol (boiling point)
- Methanamine, N, N dimethylmethanamine and N- methylmethanamine (basic strength in aqueous phase)

OR

- Give a chemical test to distinguish between N-methylethanamine and N,N-dimethyl ethanamine.
- Write the reaction for catalytic reduction of nitrobenzene followed by reaction of product so formed with bromine water.
- Out of butan-1-ol and butan-1-amine, which will be more soluble in water and why?

3

28. A metal crystallizes into two cubic system-face centred cubic (fcc) and body centred cubic (bcc) whose unit cell lengths are 3.5 and 3.0Å respectively. Calculate the ratio of densities of fcc and bcc.

3

29. Three amino acids are given below:

Alanine $\text{CH}_3\text{CH}(\text{COOH})(\text{NH}_2)$ Aspartic acid $\text{HOOC}-\text{CH}_2\text{CH}(\text{COOH})(\text{NH}_2)$ and Lysine $\text{H}_2\text{N}-(\text{CH}_2)_4-\text{CH}(\text{COOH})(\text{NH}_2)$.

- (A) Make two tripeptides using these amino acids and mark the peptide linkage in both cases.
(B) Represent Alanine in the zwitter ionic form. 3

30. (A) Arrange the following in decreasing order of bond dissociation enthalpy

$\text{F}_2, \text{Cl}_2, \text{Br}_2, \text{I}_2$

- (B) Bi does not form $p\pi-p\pi$ bonds. Give reason for the observation.
(C) Electron gain enthalpy of oxygen is less negative than sulphur. Justify. 3

SECTION - D

15 marks

Q.No. 31 - 33 are Long Answer Type Questions (LA) and carrying 5 marks each:

31. (A) Answer the following questions:

- (i) Write the balanced chemical reaction for reaction of Cu with dilute HNO_3 .
(ii) Draw the shape of ClF_3 1
(B) 'X' has a boiling point of 4.2 K, lowest for any known substance. It is used as a diluent for oxygen in modern diving apparatus. Identify the gas 'X'. Which property of this gas makes it usable as diluent? Why is the boiling point of the gas 'X' so low?

OR

(A) Answer the following questions:

- (i) Arrange the following in the increasing order of thermal stability:
 $\text{H}_2\text{O}, \text{H}_2\text{S}, \text{H}_2\text{Se}, \text{H}_2\text{Te}$
(ii) Give the formula of the brown ring formed at the interface during the ring test for nitrate.
(B) A greenish yellow gas 'A' with pungent and suffocating odour, is a powerful bleaching agent. 'A' on treatment with dry slaked lime it gives bleaching powder. Identify 'A' and explain the reason for its bleaching action. Write the balanced chemical equation for the reaction of 'A' with hot and concentrated NaOH. 2 + 3

32. An organic compound 'A' C_8H_6 on treatment with dilute H_2SO_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 AlCl_3 . 'B' on treatment with I_2 in aq. 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 5

33. (A) State Kohlrausch law.

(B) Calculate the emf of the following cell at 298 K:

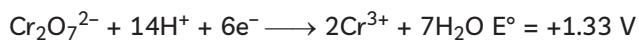
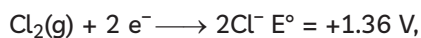
$\text{Al(s)}/\text{Al}^{3+} (0.15\text{M})//\text{Cu}^{2+} (0.025\text{M}) / \text{Cu(s)}$

(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° values identify which amongst the following is the strongest oxidising agent:



- (B) The following figure 2, represents variation of (Λ_m) vs \sqrt{c} for an electrolyte. Here Λ_m is the molar conductivity and c is the concentration of the electrolyte:

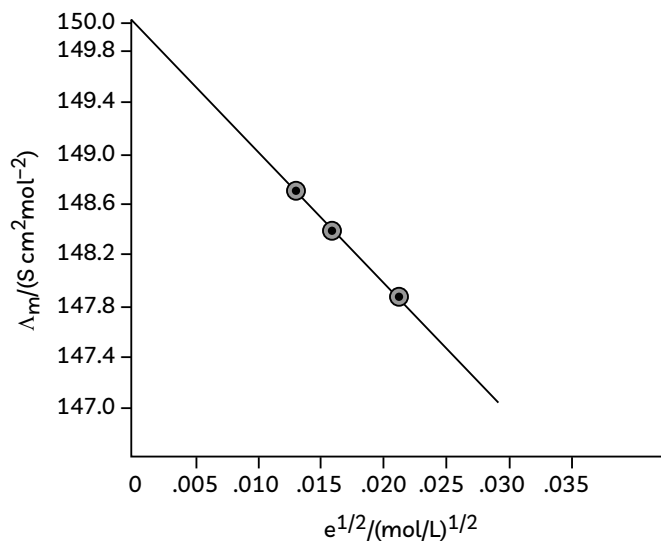


Figure 2

- Define molar conductivity.
- Identify the nature of electrolyte on the basis of the above plot. Justify your answer.
- Determine the value of Λ_m° for the electrolyte.
- Show how to calculate the value of A for the electrolyte using the above graph. 1 + 4



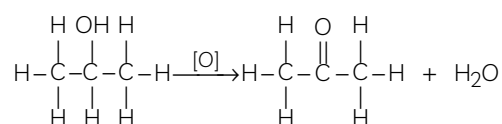
SOLUTION

Note : The text in grey boxes are the solutions given in the CBSE marking scheme 2020-2021.

SECTION - A

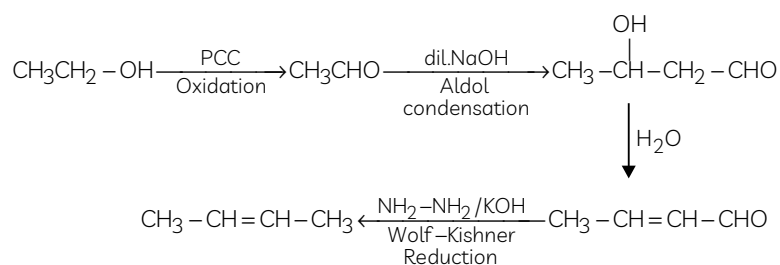
1. (A) (d) Propan-2-ol to propanone

Explanation: This conversion is carried out in the presence of the copper catalyst as well.



(B) (b) But-2-ene

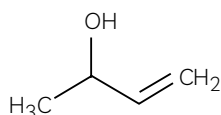
Explanation: The oxidation of ethanol based on the copper catalyst is carried out by the ozonolysis and the following product is obtained:



OR

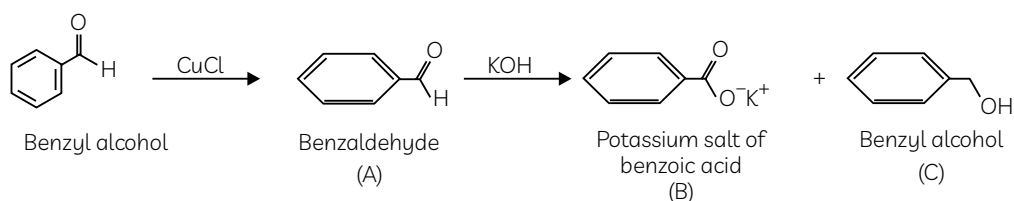
(a) But-3-en-2-ol

Explanation: The Allyl alcohol is an organic compound with the structural formula $\text{CH}_2=\text{CHCH}_2\text{OH}$ structure of But-3-en-2-ol shown alongside is an allylic alcohol.



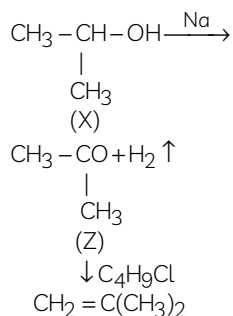
(C) (b) Benzaldehyde, potassium salt of benzoic acid, benzyl alcohol

Explanation: The sequence of the reactions is shown below:



(D) (c) $\text{CH}_2 = \text{C}(\text{CH}_3)_2$

Explanation: The sequence of the reactions is shown below:



2. (A) (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

Explanation: Vegetable tanned leather cannot adsorb a large amount of moisture because Tanning occurs due to mutual coagulation not because of the surface area of the porous materials but porous materials have large surface area. Thus, assertion and reason both are correct statements but reason is not correct explanation for assertion.

- (B) (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

Explanation: Animal hides are colloidal in nature. When the particles are soaked in tannin salts the leather hides are colloidal in nature and are positively charged thus the negatively charged tannin particles undergo mutual coagulation. This results in the hardening of leather and this process is known as tanning. Thus, Assertion and reason both are correct statements and reason is the correct explanation for assertion.

- (C) (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

Explanation: The adsorption of moisture by leather is physisorption because no new substance is formed in the reaction and the process is accompanied by the formation of multimolecular layers which is in turn accompanied by low enthalpy of adsorption, the weak forces are involved in this process of adsorption. Thus, Assertion and reason both are correct statements and reason is the correct explanation for assertion.

- (D) (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

Explanation: The leathers tanned with the vegetable tanning materials have smaller surface areas since they are composed of less hide substance and the capillaries are reduced to smaller diameters, in some cases probably completely filled by tanning materials. Thus, assertion and reason both are correct statements and reason is the correct explanation for assertion.

OR

- (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

Explanation: Leather absorbs different amount of moisture because of their smaller surface area the large size vapours do not enter these pores but the surface of leather is made in such a way that it can absorb some amount of moisture. But it is not necessary to have moisture to prevent cracking of the leather. Thus, Assertion and reason both are correct statements but reason is not correct explanation for assertion.

3. (c) $390.5 \text{ Scm}^2 \text{ mol}^{-1}$

Explanation: The limiting molar conductivity of $\text{CH}_3\text{COOH} =$

$$\begin{aligned}\lambda^\infty \text{CH}_3\text{COOH} &= \lambda^\infty \text{CH}_3\text{COONa} + \lambda^\infty \text{H}^+ - \lambda^\infty \text{Na}^+ \\ &= 91 + 349.6 - 50.1 = 440.6 - 50.1 \\ &= 390.5 \text{ S cm}^2 \text{ mol}^{-1}\end{aligned}$$



Related Theory

Molar conductivity is defined as the conducting power of all the ions produced by dissolving one mole of an electrolyte in solution. It is denoted by (λ).

Molar conductivity and specific conductivity are interrelated as:

Specific conductance is given by K and molar conductance is given by Λ

The relation between the two terms is:

$$\Lambda = K \times 1000/M$$

Also $\Lambda = \left\{ \frac{1}{R} \times \left(\frac{l}{a} \right) \right\} \times 1000/M$

Where $\Lambda =$ Molar conductance

$K =$ Specific conductance

$R =$ Resistance

$M =$ Molarity of the solution

$l =$ length

$a =$ area of cross section

4. (d) denaturation of protein

Explanation: The skin that forms on the curded milk is the phenomenon which occurs due to the denaturation of the proteins.



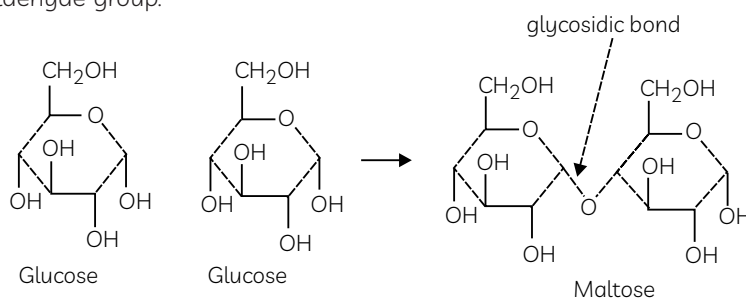
Related Theory

Denaturation is the process in which the proteins lose their native form on the application of the external factors such as strong acid, base, solvents (Both organic and Inorganic), radiation etc., in such cases proteins lose their native forms such as their Quaternary, tertiary and Secondary structures due to the breakage of the bonds and the unfolding in the molecules.

OR

(c) lactose and maltose

Explanation: Reducing disaccharides like lactose and maltose have only one of their two anomeric carbons involved in the glycosidic bond, while the other is free and can convert to an open-chain form with an aldehyde group.



Related Theory

The carbon derived from the carbonyl carbon of the open chain form of the carbohydrate molecule.

5. (c) higher percentage of benzene

Explanation: Liquids which are more volatile exert more vapour pressure. The volatile liquids are those which have weak intermolecular force of attraction. The vapour pressure of benzene is more than the vapour pressure of toluene, thus benzene is more volatile in nature and it will have higher percentage of vapours thus the solution will have higher percentage of benzene.



6. (b) higher percentage of benzene

Explanation: The electronic configuration of Zn is $[\text{Ar}] 3d^{10} 4s^2$, it has fully filled 3d subshell and it does not show variable oxidation state as well since the fully filled shells are more stable and they do not react easily.

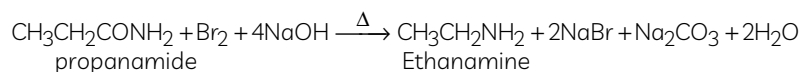
OR

- (b) Sc^{3+}

Explanation: The electronic configuration of Sc^{3+} ion is $1s^2 2s^2 2p^6 3s^2 3p^6$ thus due to the absence of unpaired electrons the Sc^{3+} ion is diamagnetic in nature.

7. (b) Ethanamine

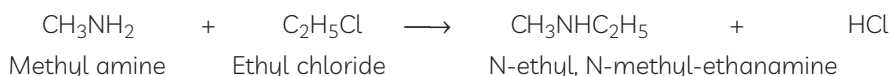
Explanation:



OR

- (d) N-Ethyl, N-methylethanamine

Explanation:



8. (a) unidentate



Related Theory

When the ligands can donate the pair of electrons from one atom, it is called unidentate ligands, e.g., NH_3 , H_2O , CN^- etc.

OR

- (a) $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Cl}]\text{Cl}_2$

9. (c) V^{3+} , V^{2+} , Fe^{3+}

Explanation: These set of ions V^{3+} , V^{2+} , Fe^{3+}

The electronic configuration of $\text{V}^{3+} = \text{Ar } 3d^3 4s^2$

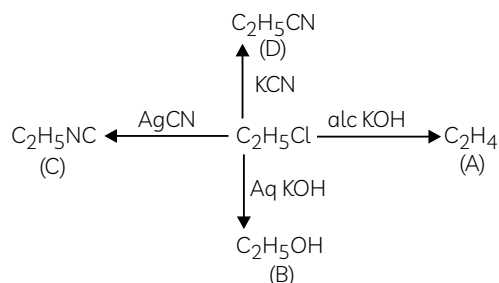
The electronic configuration of $\text{V}^{2+} = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$

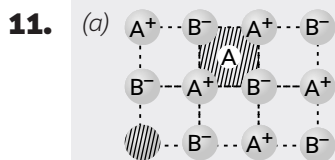
And that of Fe^{3+} is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$.

Due to the incompletely filled d subshells these ions undergo d-d transitions and thus show colour due to the electronic transitions.

10. (a) $\text{A} = \text{C}_2\text{H}_4$, $\text{B} = \text{C}_2\text{H}_5\text{OH}$, $\text{C} = \text{C}_2\text{H}_5\text{NC}$, $\text{D} = \text{C}_2\text{H}_5\text{CN}$

Explanation:





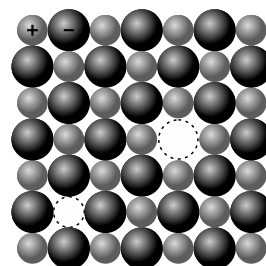
Explanation: Frenkel defect occurs only when cations are smaller in size when compared to the anions. There are also no changes in chemical properties and the density of the crystal remains as such and thus, the electrical neutrality of the crystal lattice is preserved.



Related Theory

Another defect known as the Schottky defect frequently occurs in the solids along with the Frenkel defect and the characteristics of this defect are:

- (1) In Schottky defect the difference in size between cation and anion is small.
- (2) Both anion and cation leave the solid crystal.
- (3) Atoms remain within the solid crystal.
- (4) There is formation of two vacancies.
- (5) The density of the solid decreases.



12. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

Explanation: The two strands of DNA are complementary to each other the nucleotides held together on the each strand are complementary, since the nitrogenous bases A, T, G and C are bonded through hydrogen bonds with each other. Adenine and Guanine are purine bases present in DNA and cytosine and guanine are the pyrimidines bases present in DNA and RNA both, but the pyrimidine base uracil is present in RNA whereas the base thymine is present in DNA. Thus, Assertion and reason both are correct statements and reason is correct explanation for assertion.

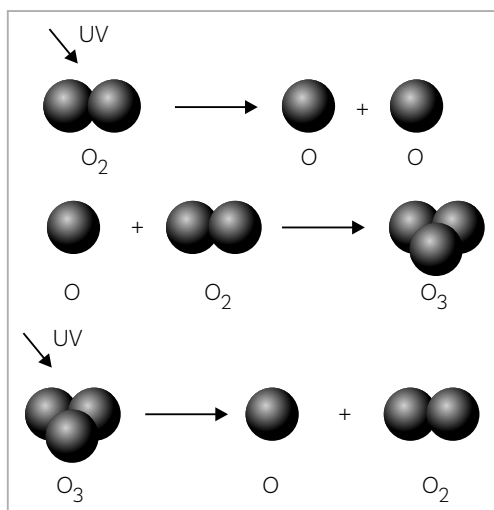


Related Theory

Adenine pairs with thymine with 2 hydrogen bonds. Guanine pairs with cytosine with 3 hydrogen bonds. This creates a difference in strength between the two sets of Watson and Crick bases. Guanine and cytosine bonded base pairs are stronger than thymine and adenine bonded base pairs in DNA.

13. (d) Assertion is wrong statement but reason is correct statement.

Explanation: The ozone molecule is thermodynamically stable because it keeps on breaking into the oxygen molecule and chlorine free radical which makes the molecule stable by its formation. The reaction occurs in the sequence of steps through which the ozone is formed in the atmosphere and the large amount of energy is liberated in this process the formation of the ozone molecule is shown by the reactions given alongside:



14. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

Explanation: The amount of oxygen dissolved in the water decreases with rise in the temperature of the water. The amount of oxygen dissolved in water for per unit area is more for cold water as compared for the warm water. Hence aquatic species are more comfortable in cold waters rather than in warm waters. Thus, Assertion and reason both are correct statements but reason is not correct explanation for assertion because the KH value of gases has nothing to do with these conditions needed for the survival of the aquatic species.

OR

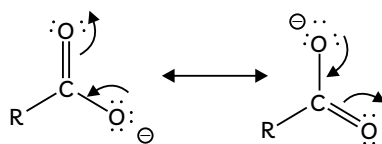
- (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

Explanation: Azeotropes are binary mixtures having the same composition in liquid and vapour phase, they boil over a range of temperature without any change in their composition. Nitric acid and water is an example of maximum boiling azeotrope. This azeotrope has an approximate composition of 68% nitric acid and 32% water by mass, with a boiling point of 393.5 K (120.4°C). Thus, Assertion and reason both are correct statements but reason is not correct explanation for assertion.

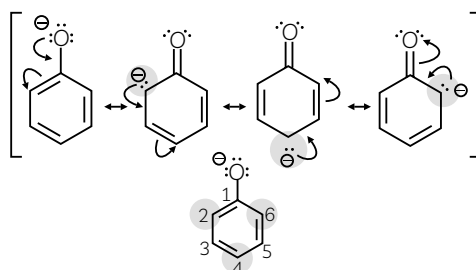
15. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

Explanation: In phenols the negative charge is less effectively delocalized over one oxygen atom and less electronegative carbon atoms in phenoxide ion while in the carboxylic acids the carboxylate ion exhibits higher stability in comparison to phenoxide ion.

The resonance in the carboxylate ion is shown below:



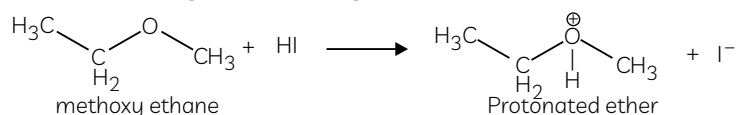
The resonance in the phenoxide ion is shown below:



Thus, Assertion and reason both are correct statements but reason is not the correct explanation for assertion. Since the stability of the ions is more predominant phenomenon.

16. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

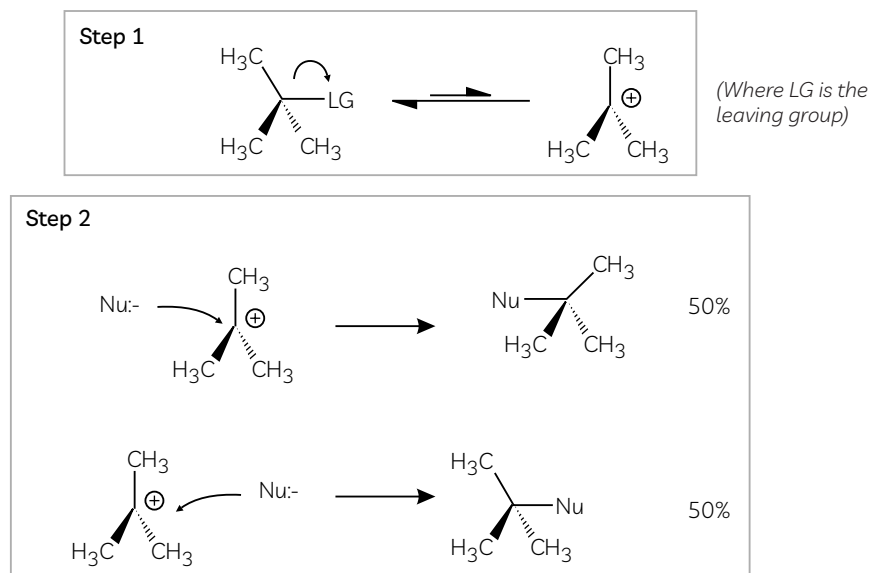
Explanation: In the cleavage of mixed ethers like methoxy ethane with two different alkyl groups, the alcohol and alkyl iodide formed, depend on the nature of alkyl group and the reaction follows the S_N1 mechanism, as shown by the reaction given below:



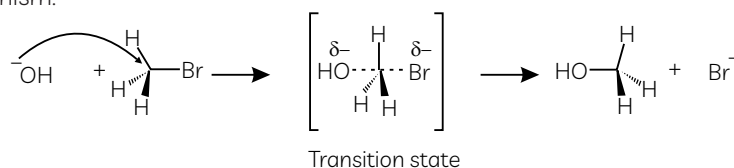


Related Theory

The S_N1 reaction mechanism can be understood through these steps given below showing that it is a two-step process and a carbocation is always formed during the course of the reaction mechanism.

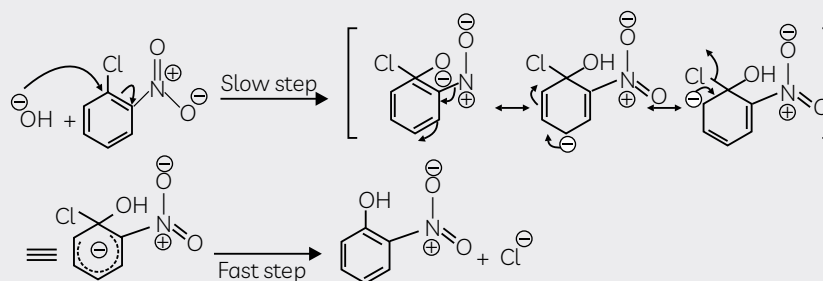


The below given reaction shows that a transition state is formed during the course of the S_N2 reaction mechanism.



SECTION - B

- 17.** Nitro group at ortho position withdraws the electron density from the benzene ring and thus facilitates the attack of the nucleophile on haloarene. The concept can be understood from the resonating structures given below:



The reaction proceeds with the formation of the Intermediate in the first step which is the slow step followed by the next reaction which is fast step of the reaction. As per the Kinetics of the reaction the formation of the intermediate in the first step determines the rate at which the reaction takes place.

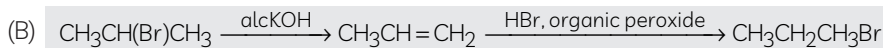
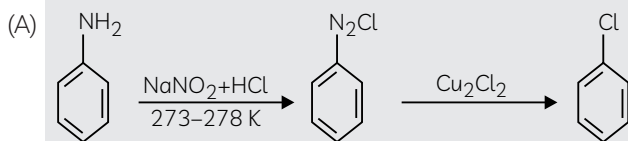


Related Theory

There are two types of groups the electron withdrawing and electron donating groups, the one which donate electrons to the ring are known as electron donating groups whereas which takes the electron from the ring are known as electron withdrawing groups. Usually the ortho and para groups are electron donating groups and meta groups are electron withdrawing groups but halogens are the exception they share the lone pair of electrons with the benzene ring.



OR



18.

$$\Delta T_b = K_f m \quad \Delta T_b = 101.04 - 100 = 1.04^\circ\text{C}$$

or

$$m = 1.04 / 0.52 = 2$$

$$\text{Relative lowering of VP} = x2$$

$$\text{Relative lowering of VP} = n_2/n_1 + n_2$$

$$= 2 / 2 + 55.5 = 2/57.5 = 0.034 \text{ atm}$$



Related Theory

The relative lowering in the vapour pressure is a colligative property since it depends on the number of the moles and can be calculated by using the different parameters such as molarity, mole fraction etc.

19.

(A) $t_{29}^4 e_g^2$ Paramagnetic

The electronic configuration of the iron ion in the complex ion $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ can be written as $t_{29}^4 e_g^2$ and it will be paramagnetic in nature due to the presence of unpaired electrons in the ion.

(B) Dichloridobis(ethane-1,2-diamine) cobalt (III) nitrate

OR

(A) Square planar

(B) $\text{Cu}^{2+} = 3d^9$ 1 unpaired electron so $\sqrt{1(3)} = 1.73\text{BM}$

The outer electronic configuration of Cu^{2+} is $3d^9$, that is it has 1 unpaired electron so magnetic moment can be calculated as $\sqrt{1(3)} = 1.73 \text{ BM}$.



Related Theory

Using the VSEPR theory, the electron bond pairs and lone pairs on the center atom the geometry of the molecule can be easily depicted whereas the shape of a molecule is determined by the location of the nuclei and its electrons.

20.

(A) Reaction is a complex reaction.

Order of reaction is 1.5.

Molecularity cannot be 1.5, it has no meaning for this reaction. The reaction occurs in steps, so it is a complex reaction.

$$\text{For the given Rate} = k [\text{A}][\text{B}]^{1/2}$$

Since the order of the reaction is $\frac{1}{2} = 1.5$ and the molecularity of the reaction cannot be equal to 1.5 thus such type of reactions are never elementary in nature they are complex in nature.

(B) units of k are $\text{mol}^{-1/2}\text{L}^{1/2}\text{s}^{-1}$



Related Theory

Order and Molecularity are the two closely related terms in the context of the chemical reactions to know the change in the concentrations of the reactants and products with the change in time but they are different the Molecularity of the reaction is the number of molecules that come together to react in an elementary (single-step) reaction and is equal to the sum of stoichiometric coefficients of reactants in this elementary reaction whereas order of the reaction is the sum of the concentration powers given in the rate law.

OR

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

from the table we know that

$$\text{Rate 1} = 3.0 \times 10^{-4} = k (0.10) \times (0.10)^y$$

$$\text{Rate 2} = 9.0 \times 10^{-4} = k (0.30) \times (0.30)^y$$

$$\text{Rate 3} = 3.0 \times 10^{-4} = k (0.10) \times (0.30)^y$$

$$\text{Rate 1/Rate 3} = (1/3)^y \text{ or } 1 = (1/3)^y$$

$$\text{So } y = 0$$

$$\text{Rate 2/Rate 3} = (3)^x \text{ or } 3 = (3)^x$$

$$\text{So } x = 1$$

$$\text{Rate} = k [P]$$



Related Theory

The order of the reaction is given by the sum of the concentration powers given in the rate law; Let the hypothetical reaction be

$$r = k [A]^x [B]^y$$

The concentration powers of A = x

And the concentration power of B = y

Therefore the sum of the powers is = {x} + {y}

$$\text{Rate} = x + y$$

21.

$$k = 0.693/t_{1/2}$$

$$k = 0.693/5730 \text{ years}^{-1}$$

$$t = \frac{2.303}{k} \log \frac{C_0}{C_t}$$

let

$$C_0 = 1 \quad C_t = 3/10 \text{ so } C_0/C_t$$

$$= 1 / (3/10) = 10/3$$

$$t = \frac{2.303}{0.693} \times 5730 \log \frac{10}{3}$$

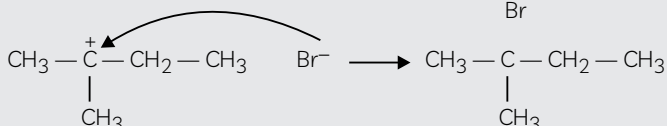
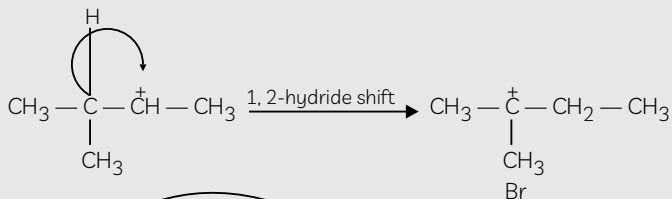
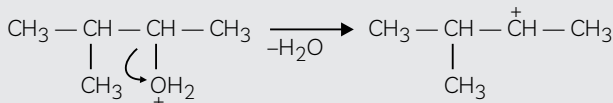
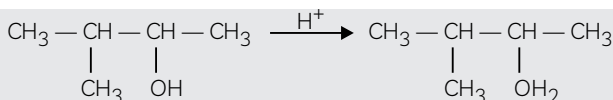
$$t = 19042 \times (1 - 0.4771) = 9957 \text{ years}$$



Related Theory

The half-life of the reaction is the time taken for the half or 50% completion of the reaction during the course of the reaction. It is the time at which the initial concentration of the products taken is exactly of the concentration taken at the start of the reaction.

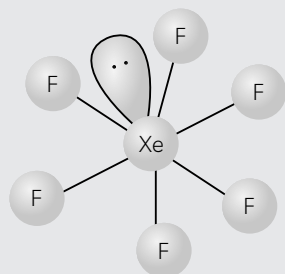
22.



The alcohol molecule undergoes nucleophilic substitution reaction by the Br^- ion when the 3-methylbutan-2-ol is treated with HBr. In order to get the stable carbocation after the loss of the H_2O^+ water molecule as a leaving group, the hydride shift takes place in the mechanism.

23. XeF_6

Central atom Xe has 8 valence electrons, it forms 6 bonds with F and has 1 lone pair. According to VSEPR theory, presence of 6 bp and 1 lp results in distorted octahedral geometry



The Nobel gas species which is iso-structural with IF_5^- is XeF_6 molecule. According to the VSEPR theory the presence of 6 bond pair (bp) and 1 lone pair (lp) results in the distorted octahedral geometry and the central atom Xe has 8 valence electrons and it forms 6 bonds with the F atom and also has 1 lone pair of electron.



Related Theory

The Valence Shell Electron Pair Repulsion Theory is abbreviated as VSEPR theory and is based on the assumption that there is repulsion between the pairs of valence electrons in all atoms, and the atoms will always tend to arrange themselves in a manner in which this electron pair repulsion is minimized. This theory helps to predict the geometry of the molecule.

- 24.** (A) inverted product will be given by 1 Chlorobutane as it undergoes SN^2 reaction.
 (B) racemic mixture will be given by 2 chloro-2-methylpropane as it undergoes SN^1 reaction.

- 25.** Let no. of Atoms of element P be x
 No. of tetrahedral voids = $2x$
 No. Of octahedral voids = x
 Atoms of Q = $\frac{1}{3}(2x) + x = \frac{5x}{3}$



Given: The atoms of P element form the ccp lattice:

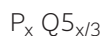
Let the number of atoms of element P be x

Number of tetrahedral voids = $2x$

Number of octahedral voids = x

Atoms of Q = $\frac{1}{3}(2x) + x$

= $\frac{5x}{3}$



So the formula of the compound will be P_3Q_5 .

SECTION - C

- 26.** (A) Due to large surface area and ability to show variable oxidation states

Transition elements act as catalysts due to the large surface area and ability to show variable oxidation states.

(B) Due to high value of third ionisation enthalpy

It is difficult to obtain oxidation state greater than two for Copper because the value of third ionisation enthalpy is very high for a copper atom.

(C) Oxidation state of Cr in Cr_2O_3 is +3 and of CrO is +2. When oxidation number of a metal increases, ionic character decreases so CrO is basic while Cr_2O_3 is amphoteric.

CrO is basic but Cr_2O_3 is amphoteric because oxidation state of Cr in Cr_2O_3 is +3 and of Cr in CrO is +2. When oxidation number of a metal increases, ionic character decreases so CrO is basic while Cr_2O_3 is amphoteric.

OR

(A) The general trend towards less negative EV values across the series is related to the general increase in the sum of the first and second ionisation enthalpies.

(B) The high energy to transform Cu(s) to $\text{Cu}^{2+}(\text{aq})$ is not balanced by its hydration enthalpy.

(C) The stability of the half-filled d sub-shell in Mn^{2+} and the completely filled d^{10} configuration in Zn^{2+} are related to their more negative E° V values

27. (A) Aniline, N-ethylethanamine, Ethanamine

The given compounds can be arranged in their increasing order of solubility in water as:
Aniline < N-ethylethanamine < Ethanamine.

The above trend is because the Primary amines are less soluble than tertiary amines as primary amines can form hydrogen bonds with water but tertiary amines cannot.

(B) Ethanamine, ethanol, ethanoic acid

The given compounds can be arranged in their increasing order of boiling point as: Ethanamine < ethanol < ethanoic acid.

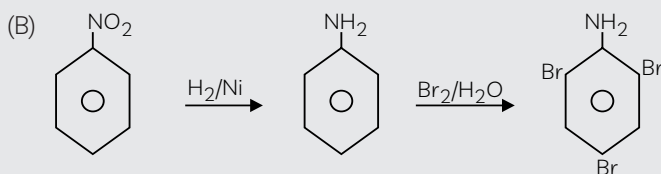
(C) N, N dimethylmethanamine, methanamine, N-methylmethanamine

The given compounds can be arranged in their increasing order of basic strength in aqueous phase) as: N, N dimethylmethanamine, methanamine, N-methylmethanamine.

OR

(A) N-methylethanamine is a secondary amine. When it reacts with benzenesulphonyl chloride, it forms N- Ethyl -N methyl sulphonamide while and N,N-dimethyl ethanamine is a tertiary amine it does not react with benzenesulphonyl chloride.

N-methylethanamine and N, N-dimethyl ethanamine can be distinguished by using benzenesulphonyl chloride. N-methyl ethanamine is a secondary amine. When it reacts with benzenesulphonyl chloride, it forms N- Ethyl -N methyl sulphonamide while N, N-dimethyl ethanamine is a tertiary amine and thus it does not react with benzenesulphonyl chloride.



(C) Butan-1-ol

Alcohol forms stronger hydrogen bonds with water than formed by amine due to higher electronegativity of O in alcohol than N in amine

28.

We know that

$$d = zM / Na a^3$$

For fcc, $z = 4$ therefore $d = 4 \times M / Na (3.5 \times 10^{-8})^3 \text{ g/cm}^3$

For bcc, $z = 2$ therefore $d' = 2 \times M / Na (3.0 \times 10^{-8})^3 \text{ g/cm}^3$

$$d/d' = 4/(3.5 \times 10^{-8})^3 / 2/(3.0 \times 10^{-8})^3 = 3.17:1$$

Given: Edge length of fcc = 3.5 Å and edge length of bcc = 3.0 Å

For a unit cell we know that:

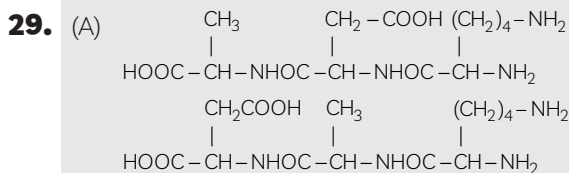
$$d = ZM / Na \times a^3$$

For fcc, $z = 4$ therefore $d = 4 \times M / Na (3.5 \times 10^{-8})^3 \text{ g/cm}^3$

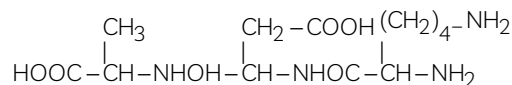
And for bcc, $z = 2$ therefore $d' = 2 \times M / Na (3.0 \times 10^{-8})^3 \text{ g/cm}^3$

$$d/d' = 4 / (3.5 \times 10^{-8})^3 / 2 / (3.0 \times 10^{-8})^3 = 3.17:1$$

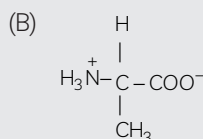
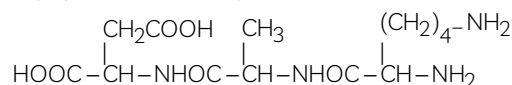
So, the ratio of densities of fcc and bcc is 3.17:1.



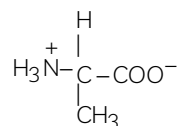
Tripeptide 1 made up of three amino acids Alanine, Aspartic acid and lysine.



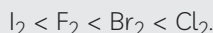
Tripeptide 2 made up of three amino acids Aspartic acid, Alanine, and lysine.



Alanine in the zwitter ionic form can be represented as follows –



30. (A) Arrange the following in decreasing order of bond dissociation enthalpy



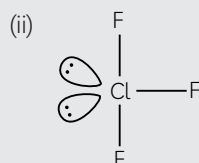
(B) Bi does not form $p\pi-p\pi$ bonds as its atomic orbitals are large and diffuse so effective overlapping is not possible

(C) Due to small size of oxygen, it has greater electron electron repulsions

Electron gain enthalpy of oxygen is less negative than sulphur because of the small size of oxygen; it has greater electron-electron repulsions which makes it difficult to accommodate a new incoming electron whereas sulphur due to its bigger size accommodates the incoming electron better.

SECTION - D

31. (A) (i) $3\text{Cu} + 8 \text{HNO}_3(\text{dilute}) \rightarrow 3\text{Cu}(\text{NO}_3)_2 + 2\text{NO} + 4\text{H}_2\text{O}$



(B) 'X' is Helium

It is used as a diluent for oxygen in modern diving apparatus because of its very low solubility in blood.

It monoatomic having no interatomic forces except weak dispersion forces and has second lowest mass therefore bp is lowest.

The boiling point of the known substance X is 4.2 K and it suggests that it is a gas. Also it is used as a diluent for oxygen in modern diving apparatus thus the gas X is Helium (He). The solubility of the He gas is very low in blood and thus it is safe to be mixed with oxygen. As it is monoatomic gas, it does not have any interatomic attractive forces except weak dispersion forces and has second lowest mass therefore its boiling point is also lowest.

OR

(A) (i) H_2Te , H_2Se , H_2S , H_2O

(ii) $[\text{Fe}(\text{H}_2\text{O})_5(\text{NO})]^{2+}$

(B) A is chlorine gas

Its bleaching action is due to oxidation.

$\text{Cl}_2 + \text{H}_2\text{O} \rightarrow 2\text{HCl} + \text{O}$, Coloured substance + O \rightarrow Colourless substance

$6\text{NaOH} + 3\text{Cl}_2 \rightarrow 5\text{NaCl} + \text{NaClO}_3 + 3\text{H}_2\text{O}$.

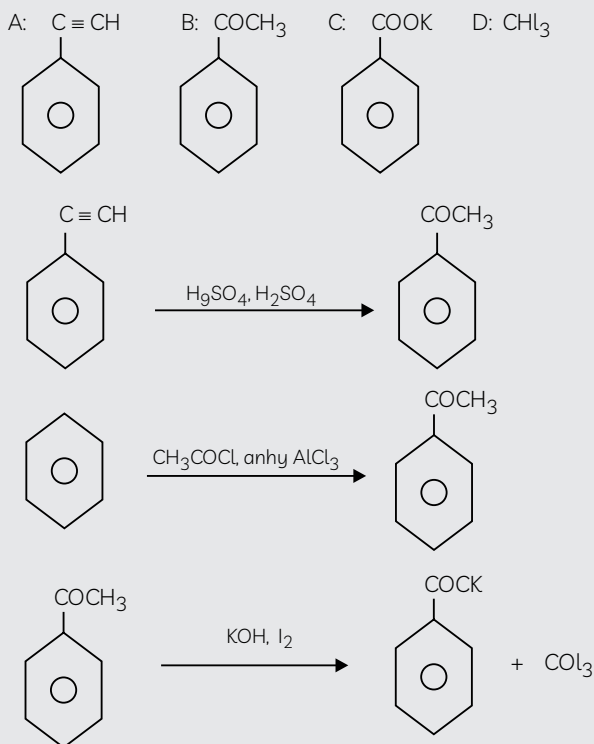
The yellow gas with pungent and suffocating odour and a powerful bleaching agent is Chlorine. The bleaching action of the chlorine gas is due to its oxidation properties. Since, chlorine belongs to group 7 and it can accept one electron to complete its octet, oxidising the other reactant as a result:

$\text{Cl}_2 + \text{H}_2\text{O} \rightarrow 2\text{HCl} + \text{O}$

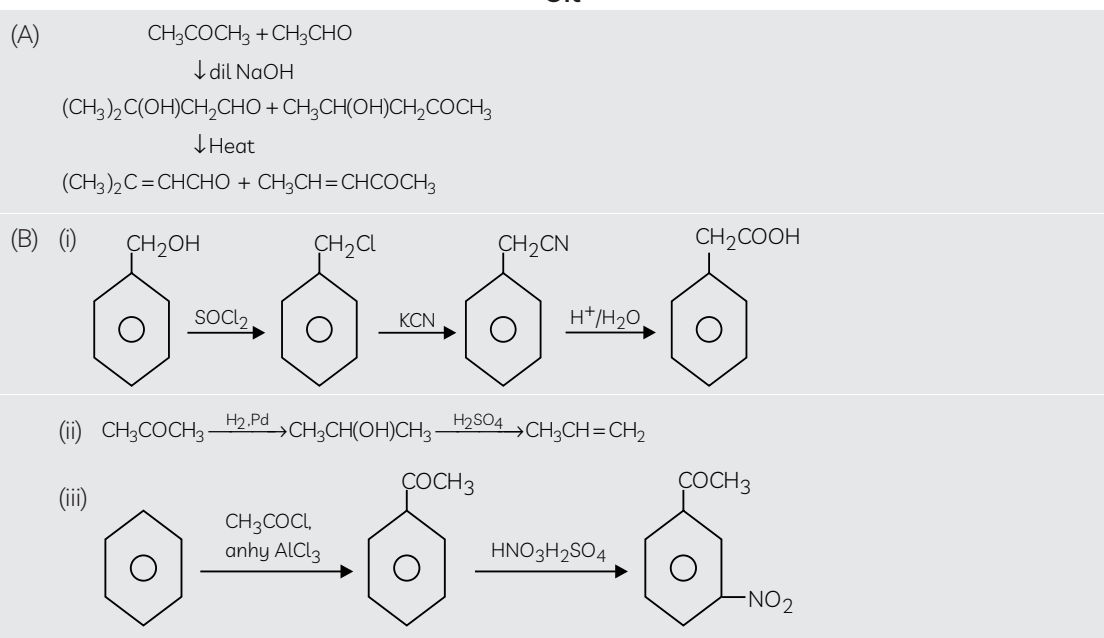
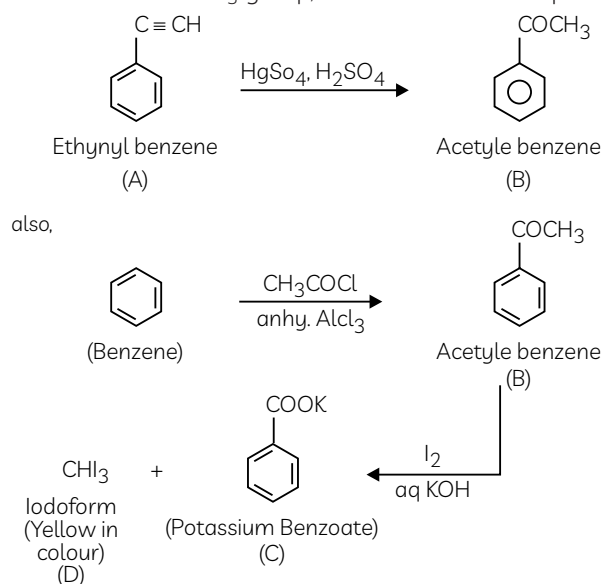
Coloured substance + O \rightarrow Colourless substance

$6\text{NaOH} + 3\text{Cl}_2 \rightarrow 5\text{NaCl} + \text{NaClO}_3 + 3\text{H}_2\text{O}$

32.



The molecular formula of the organic compound 'A' is given as C_8H_6 which indicates that it is unsaturated hydrocarbon. On treatment with dilute H_2SO_4 containing mercuric sulphate it gives compound 'B' which is also obtained when benzene undergoes Friedel Crafts acetylation (reaction with acetyl chloride in presence of $AlCl_3$). Hence the compound A has a benzene ring with an unsaturated substituent containing two carbon. As compound A reacts with dilute $H_2SO_4/HgSO_4$ and the substituent converts into $-COCH_3$ group, the structure of compound A can be given as:



- 33.** (A) a limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte.

Kohlrausch law states that limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte.

$$\Lambda_m^\infty = \nu_+ \lambda_+^\infty + \nu_- \lambda_-^\infty$$

ν_+ and ν_- are the stoichiometric coefficients for the cation and anion in the electrolyte. λ_+° and λ_-° are the ionic conductance of individual ions (cations and anions).

(B) $E^{\circ}_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}} = 0.34 - (-1.66) = 2.00 \text{ V}$

$$E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{0.059}{n} \log \frac{[\text{Al}^{3+}]^2}{[\text{Cu}^{2+}]^3}$$

Here $n = 6$

$$E_{\text{cell}} = 2 - \frac{0.059}{6} \log \frac{[0.15]^2}{[0.025]^3}$$

$$= 2 - 0.059/6 (2 \log 0.15 - 3 \log 0.025)$$

$$= 2 - 0.059/6 (-1.6478 + 4.8062) = 2 - 0.0311 = 1.9689 \text{ V}$$

In the given electrolytic reaction:



Al is undergoing oxidation hence Aluminium is anode and copper electrode is cathode. Standard EMF of the given cell can be given as follows:

$$E^{\circ}_{\text{cell}} = E^{\circ}_{\text{cathode}} - E^{\circ}_{\text{anode}} = 0.34 - (-1.66) = 2.00 \text{ V}$$

Net EMF of the given cell can be calculated as follows:

$$E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{0.059}{n} \log \frac{[\text{Al}^{3+}]^2}{[\text{Cu}^{2+}]^3}$$

Here, $n = 6$

$$E_{\text{cell}} = 2 - \frac{0.059}{6} \log \frac{[0.15]^2}{[0.025]^3}$$

$$= 2 - 0.059/6 (2 \log 0.15 - 3 \log 0.025)$$

$$= 2 - 0.059/6 (-1.6478 + 4.8062) = 2 - 0.0311 = 1.9689 \text{ V}$$

Hence, EMF of the given cell is 1.9689 V.

OR

(A) MnO_4^-

The given species can be arranged as follows according to their increasing oxidation potential— $\text{Cr}_2\text{O}_7^{2-} (+1.33 \text{ V}) < \text{Cl}_2 (+1.36 \text{ V}) < \text{MnO}_4^- (+1.51 \text{ V})$

Hence, MnO_4^- is the strongest oxidising agent.

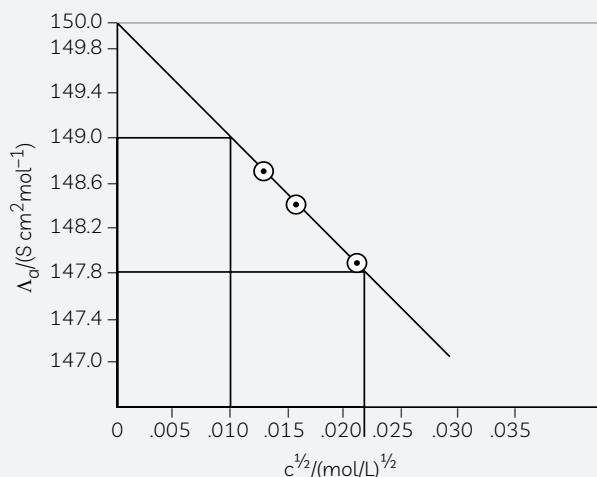
(B) (i) Molar conductivity of a solution at a given concentration is the conductance of the volume V of solution containing one mole of electrolyte kept between two electrodes with area of cross section A and distance of unit length.

(ii) Strong electrolyte, For strong electrolytes, Δm increases slowly with dilution

(iii) $\Delta m = \Delta m^{\circ} - A c^{1/2}$

$$\text{Therefore } \Delta m^{\circ} = 150 \text{ Scm}^2 \text{mol}^{-1}$$

(iv)



$$A = -\text{slope} = -(149 - 147.8 / 0.010 - 0.022) = 100 \text{ Scm}^2 \text{mol}^{-1} / (\text{mol/L}^{-1})^{1/2}.$$