

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2079 Baishakh

Exam.	Level	Back
	BE	Full Marks 80
Programme	BCE, BME, BGE, BCH	Pass Marks 32
Year / Part	I / I	Time 3 hrs.

Subject: - Engineering Chemistry (SH 403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- Give an example of an acidic buffer and show how it resists the change in its pH on addition of strong acid or base. Calculate the pH of 200 ml of 0.2 M CH_3COOH in which 100 ml of 0.15 M NaOH is added. [3+2]
- Define an electrochemical cell. What is the role of salt bridge in a voltaic cell? Calculate the emf of the following cell:
 $\text{Mn/Mn}^{2+} // \text{Fe}^{2+}/\text{Fe}$ [1+1+3]
 When an iron rod is immersed in 1.0 M FeSO_4 solution and Mn rod is immersed in 0.1 M MnSO_4 solution. Given $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = 0.44 \text{ V}$ and $E^\circ_{\text{Mn}^{2+}/\text{Mn}} = -1.18 \text{ V}$.
- Define autocatalysis with examples. Write any two criteria for choosing a catalyst for industrial purposes. Explain with an example the adsorption theory of catalysis. [2+1+3]
- What are major pollutants? Mention the possible remedies for water pollution. [1+4]
- Write short notes on: (a) Acid rain and its effect and (b) Global warming [2.5+2.5]
- Give an account of polymeric sulphur nitride and Silicones. [2.5+2.5]
- What is non-biodegradable polymer? Give the preparation and uses of Polystyrene and epoxy resins. [1+4]
- Explain diamagnetic, paramagnetic and ferromagnetic substances with example? Illustrate why does the paramagnetism in 3d – transition elements first increase, reach the maximum near the middle of the series and then decrease? [3+2]
- Explain why compounds of V^{5+} are colourless but V^{3+} are coloured.
 - Discuss complex formation in the case of transition elements. [2.5+2.5]
- $[\text{Ni}(\text{CN})_4]^{2-}$ ion has a square planar geometry and $[\text{Ni}(\text{CO})_4]$ has tetrahedral geometry. Explain this on the basis of valence bond theory and discuss their magnetic behaviour. [5]
- Define ligands. Classify them with examples on the basis of the number of donor sites. [1+2]
 - Using IUPAC names, write the formula for the following: [2]
 - Potassium tetracyanonickelate (II)
 - Pentaamminenitrocobalt (III) ion
 - Tetrahydroxozincate (II) ion
 - Chlorobis (ethylenediamine) nitrocobalt (III) chloride
- What are the characteristics of an explosive? Give the preparation and uses of 2, 4, 6-trinitrotoluene and nitrocellulose. [1+2+2]
- Define paints and mention their major requisites.
 - What are lubricants? Write the functions of lubricants. [2.5+2.5]
- Write the possible stereo isomers of 2, 3-dichloropentane and mention the possible enantiomers and diastereomers. Why is isomer less stable than trans-isomer? [3+2]
- Why does SN_2 reaction proceed with inversion of configuration only? Explain the mechanism involved in the hydrolysis of tertiary alkyl halide with aqueous NaOH . [2+3]
- What is meant by bimolecular elimination 1° reaction? Describe the mechanism for the dehydrohalogenation of 3° alkyl halide.

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2078 Kartik

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME, BCH	Pass Marks	32
Year / Part	1 / 1	Time	3 hrs.

Subject: - Engineering Chemistry (SH 403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. What is Daniel cell? Calculate the emf of the following combination. [1+4]
 $\text{Fe}^{++}(0.2\text{M}) \rightarrow \text{Fe}^{+++}(0.1\text{M}) + \text{e}^-$, $E^\circ = -0.77\text{V}$
 $\text{Cu}^{++}(0.3\text{M}) + 2\text{e}^- \rightarrow \text{Cu}$, $E^\circ = 0.34\text{V}$
2. Derive Henderson equation. To 1 liter of buffer solution containing 0.1M NH_4OH and 0.2M NH_4Cl , if 0.2 g of NaOH is added, what will be the pH of the resulting solution? [2+3]
 $[\text{pK}_b = 4.74]$
3. a) Define the terms: [2×1]
 (i) Auto Catalyst
 (ii) Catalytic poisons
 b) Describe the absorption theory of catalysis with an example. [3]
4. What is Particulate Matter (PM)? What are the types and sources of particulate matter causing air pollution? Also mention their adverse effect. [1+2+2]
5. Write the consequence of acid rain. How do oxides of Nitrogen and sulphur make water acidic? [2+3]
6. What do you mean by biodegradable polymers? Give the preparation and uses of epoxy resin and polystyrene. [1+4]
7. What is inorganic polymer? Write the preparation and uses of Polyphosphazine and Polymeric sulphur. [1+4]
8. Why are d-block elements called transition elements? Write the electronic configuration of elements of 3d series. [1.5+3.5]
9. Mention the main reasons of exhibiting variable oxidation states of transition elements. Manganese exhibits the highest oxidation state among the 3d elements, why? Cu^{+2} compounds are coloured and paramagnetic while Zn^{+2} compounds are white and diamagnetic, explain. [2+1+2]
10. Compare the magnetic behaviour of the complex $[\text{NiCl}_4]^{2-}$ and $[\text{Ni}(\text{CN})_4]^{2-}$ using valence bond theory. [2.5+2.5]
11. a) What do you understand by a chelating ligand? Describe Sidwick theory of coordination compounds with an example. [1+2]
 b) Name the following complexes by IUPAC system. [4×0.5]
 - (i) $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$
 - (ii) $[\text{Co}(\text{en})_3]\text{Br}_3$
 - (iii) $\text{K}_3[\text{Cr}(\text{NO}_3)_6]$
 - (iv) $[\text{Ni}(\text{CN})_4]^{2-}$

12. What is explosive? Write the preparations and uses of trinitrotoluene(TNT) and trinitrocellulose. [1+4]
13. a) Mention the functions of lubricant and discuss about solid lubricant. [2.5]
b) Write requisites of good paints and mention the important constituents of paints. [2.5]
14. a) Give the necessary conditions for the molecule to exhibit geometrical isomerism and write an example with Z and E notation. [2.5]
b) Write the possible optical isomer of 2, 3-dichloropentane and distinguish enantiomers and diastereomers. [2.5]
15. a) Explain the mechanism of the reaction of bromomethane in aqueous potassium hydroxide. [3]
b) What types of nucleophile and solvent favours SN_2 and SN_1 reaction mechanism? [2]
16. Discuss the mechanism for the reaction of tertiary alkyl halide with alcoholic sodium hydroxide. Write the differences between E_1 and E_2 reactions. [3+2]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BGE, BME, BCM	Pass Marks	32
Year / Part		Time	3 hrs.

Subject: - Engineering Chemistry (SH 403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- What is normal hydrogen electrode? Calculate the emf of given combination at 20°C; [2+3]
 (i) $\text{Fe}^{++}(1\text{M}) = \text{Fe}^{+++}(0.2\text{M}) + e, E^0 = -0.77\text{V}$
 (ii) $\text{Sn}^{++}(0.3\text{M}) + 2e = \text{Sn}, E^0 = -0.14\text{V}$
- Could you prepare the acidic buffer of pH = 1? Why and how? Calculate the pH of mixture obtained by mixing 50cc of 0.5N NH_4OH and 100cc of 0.2M NH_4Cl solutions. ($K_b = 1.8 \times 10^{-5}$) [2+3]
- What are the characteristics of Catalysts? Explain their activity on the basis of adsorption theory of catalysis. [2+3]
- a) Why are the oxides of sulphur called air Pollutants? [2]
 b) Mention the sources and consequences of greenhouse effect. [3]
- What are the effect of soil pollution in agriculture and living beings? How is soil pollution controlled? [3+2]
- How do you prepare polythiazyl? Mention the applications of polyphosphazines and chalcogenide glasses in engineering field. [2+3]
- Discuss about the conducting polymers. Write the preparation and uses of Teflon and epoxy resin. [1+4]
- Why are d-block elements called transition elements? Explain the origin of colour in transition metals on the basis of d-d transition. [1+4]
- Explain the followings: [2×2.5]
 - Presence of the unpaired electrons makes substance paramagnetic.
 - Variable oxidation states are the main characteristic of transition elements.
- a) Differentiate between double salt and complex salt with examples. [3]
 b) Write the IUPAC names of the followings: [2]
 - $\text{Na}_4[\text{Fe}(\text{CN})_6]$
 - $[\text{Zn}(\text{OH})_4]^{2-}$
 - $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
 - $[\text{Co}(\text{en})_2\text{Cl}_2]^+$
- Using VBT approach, explain the formulation of $[\text{Fe}(\text{CN})_6]^{3-}$ and $[\text{FeF}_6]^{3-}$ and differentiate between these two. [4+1]
- a) What is geometrical isomerism? Why is trans-isomer more stable than cis-isomer? [2]
 b) How do enantiomers differ from diastereomers? Illustrate with an example. [3]
- a) Explain the mechanism for reaction between tertiary butyl bromide with aqueous KOH. [3]
 b) How does SN_2 reaction differ from SN_1 reaction? [2]
- What is Saytzeff's rule? Explain it with an example. Explain the reaction mechanism for the dehydrohalogenation of tertiary alkyl halide. [2+3]
- Give an account of low and high explosives. Write the preparation and uses of TNT. [3+2]
- a) Show your acquaintance with liquid, semisolid and solid lubricant with examples. [3]
 b) Discuss two types of paints showing their applications in engineering works. [2]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE, BCH	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Chemistry (SH 403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
 - ✓ Attempt All questions.
 - ✓ The figures in the margin indicate Full Marks.
 - ✓ Assume suitable data if necessary.
- What is normal hydrogen electrode? How do you measure standard reduction potential of zinc electrode? Calculate the emf of the cell at 25°C, $\text{Ni}/\text{Ni}^{++}(0.8\text{M}) // \text{Ag}^+(0.2\text{M}) / \text{Ag}$
Given, $E^\circ \text{Ni}/\text{Ni}^{++} = +0.25\text{V}$, $E^\circ \text{Ag}/\text{Ag}^+ = -0.80\text{V}$. [1+1+3]
 - Explain the mechanism of basic buffer. Calculate the PH of the resulting buffer solution containing 100ml of 0.5M NH_4OH and 40ml of 1 M NH_4Cl in which 20cc of 0.5HCl is added. [2+3]
 - What is catalyst promoters? How does a catalyst increase the speed of reaction? Explain with example. Explain intermediate compound formulation theory of catalysis. [1+2+2]
 - What are the main sources of water pollution? Mention the measures to control water pollution. [2+3]
 - What is meant by ozone depletion? Write consequences of global warming and its possible remedies. [2+3]
 - What are biodegradable polymers? Write down the preparation and uses of Bakelite and Epoxy resin. [1+2+2]
 - What are polyphosphazenes? How are different types of polyphosphorzenes prepared? Mention the applications of polythiazyl in engineering field. [1+3+1]
 - Variable oxidation state is the main characteristics of transition elements, explain with reference to 3d series. [5]
 - Explain the followings.
 - Mn^{+2} is more paramagnetic than Cu^{+2} .
 - Zn^{+2} compounds are white while Fe^{+2} compounds are colored.
 - Transition elements form alloys. [2+2+1]
 - Differentiate between double and complex salts. Predict the magnetic properties of $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ with the help of EAN. [2+1]
 - Write the IUPAC name of the followings: [2]
 - $\text{Na}_3[\text{Al}(\text{C}_2\text{O}_4)_3]$
 - $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
 - $[\text{Cr}(\text{NH}_3)_6]^{3+}$
 - $[\text{Zn}(\text{OH})_4]^{2+}$
 - With the help of VBT approach, point out the differences between $[\text{Fe}(\text{CN})_6]^{4-}$ and $[\text{FeF}_6]^{3-}$ complex ions. [2.5×2]
 - Show your acquaintance with liquid and semi liquid lubricants. [2.5]
 - What do you understand by paints? Mention the requisites of a good paint. [2.5]
 - What isomerism is shown by tartaric acid and why? Write the possible forms of tartaric acid and mention enantiomers and mesocompound. [5]
 - What is S_N reaction? Explain the reaction mechanism of hydrolysis of tertiary alkyl halide by aqueous NaOH. [1+4]
 - Describe the mechanism of E^I reaction with suitable example. Give an account of Sayteff's rule. [4+1]
 - What are primary and low explosives? Write the preparation and uses of TNT and TNG. [5]

12. Write all the possible stereoisomers of tartaric acid. 'The meso form of tartaric acid cannot rotate plane polarized light.' Explain. [3+2]
13. Define the following terms: [1×5]
- a) Solid lubricant b) Enamel c) Varnish d) Semi solid lubricants
e) Emulsion paints
14. What are biodegradable polymers? Describe the preparation and uses of polystyrene. [1+2+2]
15. Describe the preparation and uses of polyphosphazene. 'The SN^1 reaction gives both retention and inversion product but SN^2 reaction favors inversion product.' Explain. [2+3]
16. What do you mean by elimination reaction? Explain the reaction mechanism of E1 reaction. [2+3]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Chemistry (SH 403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- What is single electrode potential? Write down the cell notation for standard hydrogen electrode. How will you predict the spontaneity of any redox system using emf? The value of E° for the $\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu(s)} + \text{Zn}^{2+}(\text{aq})$ is 1.10 V. What is the value of E_{cell} when the concentration of Cu^{2+} is 1.0 M and the concentration of Zn^{2+} is 0.025 M? [1+1+1+2]
- What happens when a small amount of acid or base is added on a buffer solution of acetic acid and sodium acetate? Determine the amount of sodium acetate required in 100 ml 0.2M acetic acid solution to prepare a buffer solution of pH 5.8 pK_a for acetic acid = 4.74 [2+3]
- Differentiate between negative catalysis and catalytic poisoning. How a catalyst work and what is the role of promoter? [2+2+1]
- What are the primary and secondary air pollutants? Describe with examples. What is acid rain and how does it occur? [2+1+2]
- What is water pollution? What are the major pollutants that should be monitored in order to explain the drinking water quality? [1+4]
- How do you differentiate a double salt from a complex? Explain with examples. [2]
 - Write the IUPAC name and calculate the effective atomic number of following complexes. [3]

(i) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$
(ii) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$
(iii) $[\text{Al}(\text{OH})(\text{H}_2\text{O})_5]^{2+}$
- What are low and high spin complexes? How does valance bond theory explain the geometry and magnetic behavior of a complex? Explain with reference to $[\text{Fe}(\text{CN})_6]^{3-}$ [1+2+2]
- Give the reasons for:
 - Cu^+ compounds are diamagnetic where as Cu^{++} compounds are paramagnetic. [2.5+2.5]
 - Ti^{+++} compounds are colored where as Ti^{++++} compounds are colorless.
- What are transition elements? Why are they called so? Why do transition elements form complex. [1+1+3]
- Define the following terms: [1×5]

- Primary explosives
 - Low explosives

- Secondary explosives
 - High explosives

- Tertiary explosives
- Explain the chemical separation of racemic mixture. Write the structure cis and trans isomers of cyclo-octene. [2+3]

12. Write all the possible stereoisomers of tartaric acid. 'The meso form of tartaric acid cannot rotate plane polarized light.' Explain. [3+2]
13. Define the following terms: [1×5]
- a) Solid lubricant b) Enamel c) Varnish d) Semi solid lubricants
e) Emulsion paints
14. What are biodegradable polymers? Describe the preparation and uses of polystyrene. [1+2+2]
15. Describe the preparation and uses of polyphosphazene. 'The SN^1 reaction gives both retention and inversion product but SN^2 reaction favors inversion product.' Explain. [2+3]
16. What do you mean by elimination reaction? Explain the reaction mechanism of E1 reaction. [2+3]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	1 / 1	Time	3 hrs.

Subject: - Engineering Chemistry (SH 403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- What is normal hydrogen electrode? Why is salt bridge used in the construction of galvanic cell?
Calculate the emf of the following cell at 20°C, Cr/Cr⁺⁺⁺ (0.5M) // Fe | Fe⁺⁺ (0.2M).
Given $E^\circ_{Cr/Cr^{+++}} = 0.75V$ and $E^\circ_{Fe^{++}/Fe} = -0.44V$. [1+1+3]
- Differentiate between acidic and basic buffers. 100 ml of 0.5 M NH₄OH is mixed with 400 ml of 0.1 M NH₄Cl. what will be the pH of this solution. When 20 ml of 0.5 M HCL is added to it? K_b for NH₃ = 1.8×10^{-5} [2+3]
- Define catalytic promoter and catalytic poison. Explain the adsorption theory of catalysis with a suitable example. [2+3]
- Write down the major water pollutants and their harmful effects on mankind. Mention their possible remedies. [5]
- Mention the major gases for causing green house effect and how are these gases released in the atmosphere? Mention the possible measures to control the global warming. [3+2]
- Write down the preparation of polymeric sulphur nitride. Mention the engineering applications of polymeric sulphur nitride and chalcogenide glass. [2+3]
- What are biodegradable and non biodegradable polymers? Mention the applications of Bakelite and epoxy resin. [2+3]
- What are transition elements? Explain the colour of transition elements on the basis of d to d transition. [1+4]
- What are d block elements? Why does the number of unpaired electron make the compound paramagnetic? Calculate the magnetic moment if the metal ion contains five unpaired electrons. [1+3+1]
- a) What is primary valency? Describe simple test to distinguish between the following pairs of complexes on the basis of Werner's theory, (i) [Co(NH₃)₅Cl]SO₄ and [Co(NH₃)₅SO₄]Cl.
b) Name the following complexes by IUPAC system
(i) [Cr(H₂O)₄(NH₃)₂]Cl₃ (ii) [Pt(NH₃)₂Cl₂] (iii) Na₃[Al(C₂O₄)₃]
(iv) [Co(NO₃)₆]³⁻ [2.5+2.5]
- Explain the formation of (i) [Fe(CN)₆]⁴⁻ and [FeF₆]³⁻ ions with the help of VBT approach. Explain which one is inner orbital complex and outer orbital complex. [2.5+2.5]
- What are high and low explosives? Write the important uses of TNT and TNG. [2+3]
- a) What are lubricants? Mention the function of lubricant.
b) What is paint? What are the major constituents of paint? Mention the requisites of paints. [2.5+2.5]
- What is optical isomerism? Show all the possible stereoisomers of tartaric acid indicating enantiomers and meso-forms. [1+4]
- Explain why SN¹ reaction gives the products with both retention and inversion of configuration but SN² gives only inversion of configuration. Write the mechanism of reaction between tertiary alkyl halide and aqueous sodium hydroxide. [2+3]
- Explain the mechanism of E¹ reaction with a suitable example. Write the differences between E¹ and E² reactions mechanism. [3+2]

Exam.	Back		
Level	BE	Full Marks	80
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Year / Part	1 / 1	Time	3 hrs.

Subject: - Engineering Chemistry (SH403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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- How does a **basic buffer** solution resist change in pH on the addition of small amount of acid or base? An **acidic** buffer solution of pH 4.8 has to be prepared from acetic acid of 2N and sodium acetate. What amount of sodium acetate should be added to 1L of acetic acid? Where, pK_a for acetic is 4.74. [2+3]
- What is **meant** by single electrode potential? How does it originate? What are the factors affecting the single electrode? [1+1+1]
 - Calculate the **emf** for the following cell at 25°C, [2]
 $\text{Sn(s)}/\text{Sn}^{2+}(0.15\text{M})//\text{Ag}^+(0.03\text{M})/\text{Ag(s)}$, Where $E^\circ \text{Sn}^{2+}/\text{Sn} = -0.14\text{V}$ &
 $E^\circ \text{Ag}^+/\text{Ag} = +0.80\text{V}$
- What are inhibitors? Describe the intermediate compound formation theory of catalysis with a suitable example. Point out criteria of catalysts used for industrial purpose. [1+3+1]
- What are different water pollutants? Mention the different sources of water pollution, their adverse effects and possible remedies. [1+2+1+1]
- How is ozone formed and depleted in nature? What are the consequences of depletion of ozone layer in the atmosphere? [2+1]
 - Describe the adverse effects of air pollutants and their possible remedies. [2]
- What is biodegradable polymer? Mention preparations and use of the following. [1+2+2]
 - Polyurethane
 - Nylon-6,6
- What is conducting polymer? Give the preparation and applications of: [1+2+2]
 - Polyphosphazenes
 - Polymeric Sulphure nitride $(\text{SN})_n$
- Explain the following features of transition elements with reference to 3-d transition series (i) Alloy formation (ii) Complex formation. [2.5+2.5]
- Write the possible oxidation states of Sc and Cr [1+2+2]
 - TiCl_3 is colored compound but TiCl_4 is colorless compound. Explain
 - $\text{K}_4[\text{Fe}(\text{CN})_6]$ is diamagnetic compound but $\text{K}_3[\text{Fe}(\text{CN})_6]$ is paramagnetic. Explain
- Show your familiarity with double salt, complex salts and ligands. How does Werner's theory explain the structure of complex compounds? [3+2]

11. a) Using valence bond theory, predict the geometry and magnetic properties of $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{Co}(\text{NH}_3)_6]^{2+}$ [1.5+1.5]
- b) Write the IUPAC names of the following co-ordination compounds. [2]
- i) $[\text{Na}_3[\text{Al}(\text{C}_2\text{O}_4)_3]]$
- ii) $[\text{Co}(\text{NH}_3)_2(\text{en})_2]\text{Cl}_3$
- iii) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$
- iv) $[\text{Al}(\text{OH})(\text{H}_2\text{O})_5]^{2+}$
12. What are explosives? Classify the explosives with respect to sensitivity. What are the impurities that you expect in crude product of TNT? [1+2+2]
13. a) What are the requisites of good paints? Write about enamels. [2.5]
- b) What is meant by lubricant? Write about semi solid lubricants and their uses. [2.5]
14. a) What are geometrical isomers? Show your familiarity with E and Z configuration with suitable examples. [1+2]
- b) Define Cis and trans isomers. Why is trans isomer more stable than Cis isomer? [2]
15. Define enantiomers, diastereomers, racemic mixture and meso compound with a suitable example of each. Also write their optical activity. [5]
16. Give an account of S_N reactions. Explain the reaction mechanism for the reaction between 3°alkyl halide and aqueous NaOH. [2+3]

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Level	BE	Full Marks	80
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Subject: - Engineering Chemistry (SH403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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- What is an electrochemical series? How does an electrolytic cell differ from a galvanic cell? Calculate the emf of the following cell at 25°C [1+2+2]
 $\text{Zn} / \text{Zn}^{++} (0.1\text{M}) // \text{Cu}^{++} (0.05\text{M}) / \text{Cu}$
 Given, $E^\circ \text{Zn}^{++} / \text{Zn} = -0.76\text{V}$, $E^\circ \text{Cu}^{++} / \text{Cu} = 0.34\text{V}$
- How does an acidic buffer solution containing acetic acid and sodium acetate resist the change in p^{H} in spite of the addition of the small amount of acid or base? Explain it. [2]
 - Calculate the pH of resulting solution when 0.01 mole of NaOH is added to 500ml of 0.1M acetic acid (p^{K_a} for acetic is 4.74) [3]
- What is homogeneous catalyst? How does a catalyst alter the rate of reaction? Explain with example. [1+4]
- What is water pollution? Write down the major sources of water pollution and mention the possible measure to control. How does the oxides nitrogen make the water acidic? [1+3+1]
- Write short notes on: [2.5+2.5]
 - Ozone layer depletion
 - Global warming due to air pollution
- What is conducting polymer? Describe the preparation and uses of polyurethane and Epoxy resin. [1+2+2]
- Write down the structure of cyclic and cross linked silicones and also give the engineering applications of silicones. [1+1]
 - What are the general characteristic of inorganic polymer? Write the preparation and uses of polymeric sulphur. [1+2]
- Give reasons: [5]
 - Transition elements are mostly paramagnetic
 - Transition elements and their compounds show catalytic behavior
 - $\text{Fe}_2(\text{SO}_4)_3$ is more stable than FeSO_4
 - Compound of Ti^{+3} are coloured but those of Ti^{+4} are colourless
 - Zn in 3d series is called typical transition element

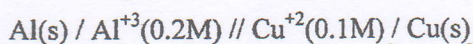
9. Write the expected and actual electronic configuration of Cr in box notation. Why the actual electronic configuration of Cr is different from expected electronic configuration? In the 3-d transition series the size of atom decreases from Sc to Cr but the size remains almost similar from Cr to Zn. Explain. [1+1+1+2]
10. How does valence bond theory explain the geometry and magnetic behavior of a complex? Explain with suitable example. [5]
11. a) Explain the formation of $[\text{FeF}_6]^{3-}$ on the basis of VBT and predict its geometry as well as magnetism. [3]
- b) Write IUPAC names of the given examples. [2]
- i) $[\text{Ni}(\text{CO})_4]$
- ii) $\text{K}_4[\text{Fe}(\text{CN})_6]$
- iii) $\text{Na}[\text{Ag}(\text{CN})_2]$
- iv) $\text{K}_2[\text{HgI}_4]$
12. What primary explosives, low explosives and high explosives? Write the preparation and uses of nitroglycerine. [3+2]
13. a) What is lubricant? In what situation grease and solid lubricant are used? [1+2]
- b) What are the characteristics of good paints? [2]
14. Explain enantiomers, racemic mixture and meso compounds with examples. Draw the structures and specify Z and E configuration of 4-methyl hept 3-ene and 2-chloro pent 2-ene. [3+2]
15. Describe the bimolecular nucleophilic substitution reaction in haloalkane with suitable example. What type of solvent is favourable for this reaction? Write down the differences between $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ reactions? [2+1+2]
16. Explain the reaction mechanism of dehydrohalogenation of tertiary butyl bromide by alcoholic caustic soda. Mention the factors governing the mechanism of E1 reaction. [3+2]

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	1 / I	Time	3 hrs.

Subject: - Engineering Chemistry (SH403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is meant by Normal Hydrogen Electrode? Discuss its use to measure standard electrode potential of copper electrode. Calculate Emf of the following cell at 20°C.



Given: $E^0_{\text{Al}/\text{Al}^{+3}} = +1.66\text{V}$ and $E^0_{\text{Cu}/\text{Cu}^{+2}} = -0.34\text{V}$

[1+1.5+2.5]

2. What is meant by 'buffer solution' and buffer action? A litre of solution containing 0.5 mole of CH_3COOH and 0.5 mole of CH_3COONa provides a buffer of pH 4.74. Calculate the pH of solution after the addition of 0.02 mole NaOH [$K_a = 1.8 \times 10^{-5}$] [2+3]
3. Define Heterogenous catalysis. What are the general characteristics of a catalyst? Explain adsorption theory of catalysis. [1+2+2]
4. Write short notes on: [2.5+2.5]
 - a) Global warming
 - b) Acid Rain
5. What is soil pollution? Point out major soil pollutants, their effects and possible remedies? [1+4]
6. a) Why do the transition elements form complexes? [2.5]
b) Why do the transition metals exhibit variable valency? [2.5]
7. a) What are transition elements? Which of the d-block elements are not considered as typical elements and why? [1+2]
b) Write the electronic configuration and group of the following elements Cr, Fe, Cu and Zn. [2]
8. $[\text{Fe}(\text{CN})_6]^{3-}$ and $[\text{FeF}_6]^{3-}$, both are octahedral complexes. Explain the difference between these two complexes on the basis of VBT. [5]
9. a) How do you distinct a double salt from a complex salt?
b) Write the IUPAC names of the following co-ordination compounds.
 - (i) $[\text{Co}(\text{H}_2\text{O})_2(\text{OH})_4]^-$
 - (ii) $[\text{Ni}(\text{CN})_4]^{2-}$
 - (iii) $\text{K}_3[\text{Al}(\text{C}_2\text{O}_4)_3]$
 - (vi) $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$[3+2]
10. Define the following terms with example. [1×5]
 - a) pigment
 - b) thinner
 - c) solid lubricant
 - d) varnishes
 - e) lacquers
11. Write the differences between organic and inorganic polymers. Write the preparation and applications of polyphosphazines. [2+3]

12. Write the method of preparation and two important uses of Bakelite and polyurethane. [2.5+2.5]
13. Write preparation and two important uses of
a) TNT b) TNG [2.5+2.5]
14. How do enantiomers differ from diastereomers? Write all the possible stereoisomers of a compound that contain two asymmetric carbon atoms. [3+2]
15. What is elimination reaction? Explain the reaction mechanism for the dehydrohalogenation of primary alkyl halide. [1+4]
16. What are the factors affecting S_N^1 and S_N^2 reactions. Explain S_N^2 reaction mechanism with reference to hydrolysis of alkyl halide. [2.5+2.5]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Chemistry (SH403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is salt bridge? Write its functions. Write electrode reaction, net cell reaction, EMF of the cell at 25°C and cell notation of the following electrode couple and also predict the spontaneity of the cell reaction. [1+1+3]

$$E^0 \text{Fe/Fe}^{++} = 0.44\text{V}, \quad E^0 \text{Ag/Ag}^+ = -0.80\text{V}$$

$$[\text{Fe}^{++}] = 0.01\text{M}, \quad [\text{Ag}^+] = 0.1\text{M}$$

2. What is buffer capacity? Write the characteristics of buffer solution. 200 ml of 0.1M $\text{C}_6\text{H}_5\text{COONa}$ is mixed with 400 ml of 0.2 M $\text{C}_6\text{H}_5\text{COOH}$ at 30°C dilute solution. Calculate the pH of solution. [1+2+2]
3. Explain the terms: (a) Acetocatalyst (b) Catalytic poisoning and (c) Promoters. [2+3]
4. Explain the mechanism of ozone layer depletion. Write its preventive measures and secondary pollution effects in troposphere. [2+1.5+1.5]
5. Define soil pollution. Write the major sources of soil pollution, their negative effects and control measures. [1+2+2]
6. Write short notes on: [2.5×2]
- Polyphosphazene
 - Chalcogenide glasses
7. a) Give an account for biodegradable and non biodegradable polymer with suitable example.
- b) What are fibers reinforced plastics? Write down the characteristics and its application. [2.5+2.5]
8. What are transition elements? How do they show: (i) catalytic behaviour (ii) coloured ions and (iii) variable oxidation states? [0.5+1.5+1.5+1.5]
9. Explain the formation of $[\text{NiCl}_4]^{2-}$ and $[\text{Ni}(\text{CN})_4]^{2-}$ on the basis of VBT of coordination compounds. [2.5×2]
10. a) Write the formula of the following IUPAC name: [2]
- Potassium penta cyano nitrosyl ferate (III)
 - Pentaammine chloro cobalt (III) ion
 - Tetracarbonyl cobalt (0)
 - Pentamminenitrito cobalt (III) sulphate
- b) " $[\text{Fe}(\text{CN})_6]^{4-}$ is diamagnetic but $[\text{Fe}(\text{CN})_6]^{3-}$ is paramagnetic" justify. [1.5+1.5]

11. What are lubricants? What are the characters of good lubricants? What is emulsm paint?
Write its applications? [1+2+1+1]
12. Define explosive. How it is used for defense purpose? What are the uses of TNT, TNG
and cellulose nitrate? [1+1+1+1+1]
13. What are geometrical isomers? Geometrical isomer is not possible in the compound
 $\text{CH}_3\text{CH}=\text{CH}_2$ explain. Why are trans isomers more stable than Tis-isomers? [1+2+2]
14. What is a nucleophilic substitution reaction? Differentiate between SN^2 and SN^1
reactions. Write the factors affecting SN^2 and SN^1 reactions. [1+2+2]
15. Explain reaction mechanism for dehydrohalogenation of tertiary butyl bromide. What
solvent favours the reaction mechanism? [4+1]
16. Write ground state electronic configuration of 3d transition series. How do you explain
the formation of complexes by 3d transition elements? [2+3]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Chemistry (SH403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- What is buffer solution? Derive Henderson's equation for basic buffer. Calculate pH of a mixture of 10 ml of 0.1M ammonium chloride solution and same volume of 0.2 M ammonia solution. (pK_b for ammonia solution = 4.74). [1+1+3]
- How does a galvanic cell generate electricity? Construct a cell with the following cell reaction, write its notation and calculate standard emf of the cell. [1+1+1+2]

$$2\text{Al} + 3\text{ZnSO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + 3\text{Zn}$$

(1M) (1M)

Given, standard reduction potential of Al and Zn are -1.66V and 0.76 V respectively.
- What is catalysis? Explain intermediate compound formation theory and an industrial application of catalysis. [1+2.5+1.5]
- What are the parameters of water pollution? Explain its causes and adverse effects. [3+1+1]
- Write the functions of lubricant. Show your acquaintance with fluid film lubrication and its role in engineering. Give an example each of (a) semi solid lubricant and (b) emulsion. [1+2+1+1]
- Write short notes on: (any two) [2.5+2.5]
 - Global warming
 - Formation and depletion of ozone layer
 - Acid rain and its effects
- What is conducting polymer? Give an account of polyphosphazenes and chalcogenide glasses. Also write their applications in engineering field. [1+2+2]
- Explain the following: [2+3]
 - 3d- transition series show variable oxidation states
 - Completely filled 3-d transition series are unable to form coloured compounds
- What is a complex ion? Give example of a (i) complex cation and (ii) complex anion, with their IUPAC name. Also calculate EAN of central metal of these ions. [1+1+1+1+1]
- Show your acquaintance on the basis of hybridisation with inner orbital and outer orbital complexes with example. [2.5+2.5]
- Differentiate between high explosive and low explosives. Write the preparation and applications of TNT. [3+2]
- Write the method of preparation and uses of (a) polystyrene (b) Bakelite [2.5+2.5]
- Distinguish between enantiomers and diastereomers. Show all optical isomers of (a) 3-Bromo 2-butanol and (b) Tartaric acid. Also show optically inactive meso form of tartaric acid. Explain why 3-Bromo 2-butanol doesn't exist in meso form. [1+1.5+1+1+0.5]
- Explain E₂ and E₁ reactions with reference to dehydrohalogenation of haloalkane and point out the factors affecting these mechanism. [1.5+1.5+2]
- Why does haloalkane favour S_N reaction? Explain why there is only inversion product in S_N2 and both inversion and retention products in S_N1 path. [1+2+2]
- What is plastic explosive? Write preparation of 1,3,5-trinitrobenzene.

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INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Chemistry (SH403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- Derive Henderson equation for buffer solution. What is the pH of resulting mixture obtained by mixing of 100 cc of 0.2 N HCL and 50 cc of 0.5M ammonia solution, K_b for ammonia is 1.8×10^{-4} . [1+4]
- How can you measure the standard reduction potential of Zn electrode? Hydrogen electrode at 1 atm is connected with Zn electrode in which the emf of the cell is found to be 0.61 V at 25°C. If $[Zn^{++}] = 1.0$ M, calculate H^+ in hydrogen electrode. [2+3]
- What is heterogeneous catalysis? Giving a suitable example, explain the mechanism of heterogeneous catalysis. Write any two criteria for choosing a catalyst for industrial purpose. [1+3+1]
- a) What do you mean by CFC? Mention their photolytic reactions in high altitude at stratosphere.
 - b) How do the oxides of sulphur and nitrogen make water acidic? [1+2+2]
- Write major sources of water pollution. How does CO_2 act as pollutant of the atmosphere? Explain. [[2+3]
- Give an account on chalcogenide glasses and polysulphur nitride. [2.5+2.5]
- Explain about the biodegradable and non-biodegradable polymers with suitable examples. [2.5×2]
- Explain giving reasons.
 - a) Transition metals and their compounds show paramagnetic behavior. [2.5]
 - b) Zinc (II) Compounds are white and diamagnetic while copper (II) Compounds are colored and paramagnetic. [2.5]
- Transition elements formed colored compounds. Explain this on the basis of d to d transition. [5]
- Compare the magnetic behavior of the complex entities $[Fe(CN)_6]^{4-}$ and $[FeF_6]^{3-}$ using valence bond theory. [2.5+2.5]
- a) Write the IUPAC name of the following co-ordination compounds. [2]
 - i) $[Cr(NH_3)_6]^{3+}$
 - ii) $[Pt(NH_3)_2Cl_2]$
 - iii) $Na_3[Cr(C_2O_4)_3]$
 - iv) $[Co(NH_3)_4Cl_2]Cl$
 - b) What is EAN? How would you explain the stability and magnetic behavior of a complex compound by EAN rule. [3]

12. a) Write the characteristics of a good paint and explain the method of application of paint in galvanized iron.
- b) Mention the types and functions of lubricants with examples. [2+1+2]
13. a) What isomerism is shown by lactic acid? Write its possible isomers. [2]
- b) What do you mean by racemic mixture? Explain chemical resolution of a racemic mixture. [1+2]
14. a) Describe SN^1 reaction mechanism in haloalkane shown stereochemistry.
- b) Why does nucleophile attack the substrate molecule from backside in SN^2 reaction mechanism? [4+1]
15. Discuss E^1 reaction with reference to the dehydrohalogenation of alkyl halide. How does E^1 differs from E^2 reaction. [3+2]
16. What are plastic explosives? Write down the characteristics of explosives. Give the preparation and uses of explosive obtained from toluene. [1+2+2]

01/06

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE, B.Agric.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Chemistry (EG403SH)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

Group A

1. a) What are the limitations of Bohr's atomic theory? [4]
b) State and explain Hund's rule of maximum multiplicity. [4]
2. a) Define a buffer solution. Explain the mechanism of a buffer action. [2+3]
b) What is the pH of a buffer solution having 0.20M acetic acid and 0.1M sodium acetate, K_a for acetic acid is 1.8×10^{-5} ? [3]
3. a) How does a galvanic cell differ from an electrolytic cell? [3]
b) Define standard electrode potential. [1]
Calculate the emf of the following cell at 25°C . [4]
 $\text{Zn/Zn}^{++} (0.025\text{M}) // \text{Cu}^{++} (0.1\text{M})/\text{Cu}$
 $E^\circ \text{Zn}^{++}/\text{Zn} = -0.76\text{V}, \quad E^\circ \text{Cu}^{++}/\text{Cu} = 0.34\text{V}$
4. a) Derive an expression for the work done in an isothermal reversible expansion of an ideal gas. [4]
b) How is C_p of a gas related to C_v ? [4]

OR

[2x4]

Write short notes on

- a) Hess's law of constant heat summation
- b) Calorific value of food and fuel

Group B

5. a) How does Werner's theory explain the structure of coordination compounds? [4]
b) Write the formula of following; [4]
 - i) Triamminechlorocyanonitrocobalt(III)
 - ii) Diamminesilver(I) chloride
 - iii) Potassium hexacyanoferrate(III)
 - iv) Pentaamminechlorocobalt(III) ion

OR

- b. What are complex salts and double salts? [4]
- c. Explain the geometry and magnetic property of $[\text{Fe}(\text{CN})_6]^{4-}$ on the basis of valence bond theory. [4]

6. a) Explain the geometry of PCl_5 on the basis of hybridization. [6]
b) Explain the formation of O_2 on the basis of valence bond theory. [2]
7. a) What are transition elements? Briefly discuss any two features of transition elements. [6]
b) Give the uses of silicones. [2]

Group C

8. Explain SN_1 and SN_2 reaction mechanism briefly. [4+4]
OR,
- a) Briefly discuss E_1 reaction mechanism with appropriate example. [4]
b) Show your familiarity with Pinacol Pinacolone rearrangement. [4]
9. a) What are geometrical isomers? [2]
b) Define enantiomers and diastereomers with suitable examples. [3+3]
10. a) Give the preparation and uses of bakelite or Nylon-66. [4]
b) List the uses of explosives. Give the preparation of trinitrotoluene (TNT). [1+3]

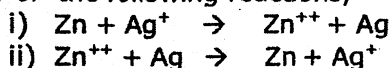
03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Chemistry (SH403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Define a galvanic cell. What are functions of salt bridge in a galvanic cell?
Predict the feasibility of the following reactions,



Given, $E^0_{\text{Zn}^{++}/\text{Zn}} = -0.76\text{V}$, $E^0_{\text{Ag}^+/\text{Ag}} = 0.80\text{V}$ [1+1+3]

2. What is a buffer solution? Discuss the mechanism of buffer action with suitable examples. [1+4]
3. What is meant by catalysis? Point out its importance. Discuss intermediate compound formation theory of catalysis. [1+1+3]
4. a) Point out the sources of radioactive substances responsible for environmental pollution. Give their adverse effects and protective measures. [2.5]
b) Briefly discuss any two sources of organic and inorganic substances responsible for water pollution. Point out their possible remedies. [2.5]
5. a) How do exhausts of internal combustion engine pollute air? Give the possible remedies. [3]
b) What is the photochemistry behind ozone layer depletion? [2]
6. a) What are Chalcogenide glasses? Give their uses. [2.5]
b) Give the preparation and applications of silicone rubbers. [2.5]
7. a) Give the preparation and applications of polystyrene and polyurethanes. [4]
b) What are the advantages of conducting polymers? [1]
8. Why do transition elements form complexes? List the industrial application of 3d transition elements in engineering. [3+2]
9. Explain the following features of transition elements with reference to 3d transition series; [2.5+2.5]
a) Variable oxidation state
b) Formation of colored compounds
10. Differentiate between complex salts and double salts. How does Werner's theory explain the bonding in complex salts? [1+4]

11. a) Write the IUPAC name of following; [2]
i) $K_2[HgI_4]$
ii) $K_4[Fe(CN)_6]$
iii) $[Co(NH_3)_5Cl]^{2+}$
iv) $Li[AlH_4]$
b) How does valence bond theory explain the formation of $[Ni(NH_3)_6]^{2+}$? Predict its magnetic behaviour. [3]
12. What are primary explosives, low explosives and plastic explosives? Give the preparation and applications 2,4,6-Trinitrotoluene (TNT). [3+2]
13. a) Show your familiarity with liquid, semi solid and solid lubricants giving examples. [3]
b) Discuss any two types of paints showing their applications in engineering works. [2]
14. a) What are geometrical isomers? Give an example. [2]
b) Show your familiarity with diastereomerism. [2]
c) Draw the structure of 2-Chlorobutane specifying *R* and *S* configuration. [1]
15. Discuss the unimolecular nucleophilic substitution reaction mechanism in alkyl halide showing the stereochemistry. [5]
16. What is meant by elimination reaction? Discuss E1 and E2 reaction mechanism. [1+4]

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / I	Time	3 Hrs.

Subject: - Engineering Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- What is galvanic cell? Write electrode reaction, net cell reaction, EMF of the cell and cell notation of given electrode couple and also predict the spontaneity of the cell reaction. [1+4]
 $E^\circ \text{Zn/Zn}^{++} = 0.76\text{V}$, $E^\circ \text{Ag}^+/\text{Ag} = 0.80\text{V}$
 $[\text{Zn}^{++}] = 0.01\text{M}$, $[\text{Ag}^+] = 0.1\text{M}$
- How does an acidic buffer solution reserve its PH value on the addition of strong acid or strong base? 100ml of 0.2M CH_3COONa is mixed with 200ml of 0.3M CH_3COOH , which is 2.1% ionised in dilute solution. Find out the PH of the resulting solution. [2.5+2.5]
- Write the adsorption theory to describe the mechanism of heterogeneous catalysis with a suitable example. How does a promoter enhance the catalytic action? List any two criteria of catalysed reactions applicable for the industries. [3+1+1]
- Write short notes on: (any two) [2.5+2.5]
 - Green house effect
 - Formation and depletion of ozone layer
 - Acid rain
- List out four major pollutants of air, their adverse effects on human health and also write their possible remedies. [1+2+2]
- Write the method of preparation and two important uses of each of polyurethane and diamine epoxy resin. [2.5+2.5]
- What is biodegradable polymer? Describe the contribution of carbon fibre reinforced polymer and chalcogenide glass in engineering. [1+4]
- What are transition elements? Which of the 3d series elements is not a transition element and why? [1+2]
 - Explain why compounds of V^{+5} are colourless but those of V^{+3} are colourful. [2]
- Explain the cause of origin of paramagnetism in transition elements. [3]
 - Explain why are transition elements good for alloy formation. [2]
- What is meant by effective atomic number of metal ion in the complex salt? What information does it convey? [2]
 - Explain the formation of $[\text{Ni}(\text{CO})_4]^\circ$ complex on the basis of VBT. Also predict its geometry and magnetism with reason. [3]
- a) Write the basic assumptions of Werner's theory of co-ordination compounds. [3]

b) Write the IUPAC names of the following co-ordination compounds. [2]

- i) $[\text{Co}(\text{NH}_3)_2(\text{en})_2]\text{Cl}_3$
- ii) $[\text{Al}(\text{OH})(\text{H}_2\text{O})_5]^{2+}$
- iii) $\text{K}_4[\text{Fe}(\text{CN})_6]$
- iv) $\text{K}[\text{Ag}(\text{CN})_2]$

12. What is plastic explosive? How do you prepare dynamite and gun cotton? [1+2+2]

13. a) What is paint? Write characteristics of a good paint and explain the method of application of paint in galvanised iron. [0.5+1+1]

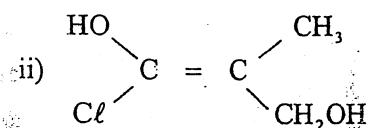
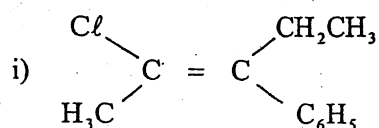
b) What is lubricant? Give an example of emulsion and solid lubricant. Mention their specific functions. [0.5+1+1]

14. a) Distinguish between enantiomers and diastereomers. Write all possible stereoisomers of a compound that contain two asymmetric carbon atoms but cannot exist in meso forms. [4]

b) Write the cis and trans isomers of butenedioic acid. [1]

15. a) What is resolution? Explain the method of chemical resolution of a racemate. [3]

b) Determine E or Z configuration in the following molecules: [2]



16. What is a nucleophilic substitution reaction? Briefly explain SN^2 and SN^1 paths of such reaction in haloalkane. Mention the factors governing these paths. [1+2+2]

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- How does electrode potential originate? Define standard electrode potential? Write the cell notation, and cell reaction for Zn-Cu cell. [2+1+2]
- What is buffer solution? Calculate the pH of resulting solution when 0.005 mole of KOH is added to 200 ml of 0.1N acetic acid solution. ($pK_a = 4.74$). [1+4]
- What is meant by homogeneous catalysis? Describe the intermediate compound formation theory of catalysis with a suitable example. List the criteria for choosing a catalyst for industrial application. [1+3+1]
- What are chlorofluorocarbons? Give their photolytic reactions in the upper atmosphere. [3]
 - Why oxides of sulphur and nitrogen are assumed as air pollutants? [2]
- Point out four major pollutants of water, their adverse effect on human health and also mention their possible remedies. [2+1+2]
- Describe the preparation and uses of polyphosphazenes and polymeric sulphur (PS)_n. [5]
- What are double and complex salts? Write the formulae of the following co-ordination compounds. [2+3]
 - Dibromotetraaquo chromium (III) chloride
 - Potassium hexacyanocobaltate (II)
 - Tetrabromocuparate (II)
 - Tetraamminedichlorocobalt (III)
 - Hexacyanoferrate (III) ion
 - Sodium trioxalato aluminate (III)
- What are principal and auxiliary valencies of the metal ion in the complex compound? Illustrate them in $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$. [2]
 - Show your familiarity with electronic interpretation of complexes. [3]
- Explain the followings: [3+2]
 - Transition elements are good in forming complexes
 - Show your acquaintance with application of 3-d transition elements.
- What are transition elements? Explain the following features of transition elements; [1+2+2]
 - Variable oxidation state
 - Magnetic properties

11. Define explosives? Give the preparation, properties and uses of trinitrotoluene (TNT).
What are plastic explosives? [1+3+1]
12. Define lubricants and mention their functions. Name different types of liquid lubricants with examples. Show your familiarity with types of paint. [2+1+2]
13. a) What are geometrical isomers? Draw the structure of 2-Chloro-3-methylpent-2-ene and specify Z and E configuration. [1+1]
b) Illustrate enantiomerism with an example. Mention a typical organic molecule which exhibits distereomerism. [1+2]
14. Describe the mechanism involved in the reaction between a tertiary alkyl halide and aqueous caustic potash. How does S_N2 reaction differ from S_N1 in its stereochemistry? [4+1]
15. a) Write the mechanism of bimolecular elimination reaction. [2]
b) Mention the effect of nucleophile, substrate and solvent on nucleophilic substitution reaction mechanisms. [3]
16. What are bio-degradable and nonbiodegradable polymers? Mention the uses of epoxy resin and fibre reinforced polymer. [2+3]

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

Group A

1. a) - A cricket ball of mass 250g is moving with $\frac{1}{1000}$ th of the velocity of light. Calculate the wavelength of that ball. Also explain whether this cricket ball acts as a particle or wave and why? (Planck's constant = 6.6×10^{-34} JS) [3]
 - b) Explain Sommerfield model of atom. How does this model introduced the concept of sub-shell? [3]
 - c) State Paulie's exclusion principle. How does this principle limit only two electrons in an orbital with their spin opposite? [2]
2. a) Derive Ostwald's dilution law and write its limitations. [4]
 - b) Calculate the pH of the resulting buffer, when 400 ml of 0.2M acetic acid is mixed with 500 ml of 0.3M sodium acetate. ($K_a = 1.8 \times 10^{-5}$) [4]
3. a) Define normal hydrogen electrode. How it is used for the construction of electrochemical series. [4]
 - b) Calculate the EMF of the following cell at 15°C. [4]

$\text{Cu} / \text{Cu}^{++} (0.1\text{M}) // \text{Ag}^+ (0.2\text{M}) / \text{Ag}$
 $E^\circ \text{Cu}^{++} / \text{Cu} = 0.34\text{V}$
 $E^\circ \text{Ag} / \text{Ag}^+ = -0.80\text{V}$
4. What do you mean by Molar heat capacities at constant volume and constant pressure? Calculate the enthalpy change for the synthesis of urea [3+5]

$\text{C(S)} + 2\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) + \text{N}_2(\text{g}) \rightarrow \text{CO(NH}_2)_2(\text{S}) \quad \Delta H = ?$
 from the following thermochemical equations.

 - a) $\text{C(S)} + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) \quad \Delta H = -394 \text{ kJ}$
 - b) $\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\ell) \quad \Delta H = -286 \text{ kJ}$
 - c) $\text{CO(NH}_2)_2(\text{S)} + \frac{3}{2}\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\ell) + \text{N}_2(\text{g}) \quad \Delta H = -632 \text{ kJ}$

OR

Write short notes on (any two):

[4+4]

- a) Electrochemical theory of corrosion
- b) Bomb calorimeter
- c) Hess law of constant heat summation

Group B

5. a) Explain the structure of $\text{CoCl}_3.6\text{NH}_3$, $\text{CoCl}_3.5\text{NH}_3$, $\text{CoCl}_3.4\text{NH}_3$ and $\text{CoCl}_3.3\text{NH}_3$ on the basis of Werner's theory, if 3, 2, 1 and 0 chloride ions are precipitated with AgCl from their aqueous solutions. [6]
- b) Explain why octahedral complexes of Ni^{+2} ion are outer orbital complex. [2]

OR

On the basis of VBT, explain the structure and hybridization involved in $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{NiCl}_4]^{2-}$ ions. [3+3+2]

Write the IUPAC name of the following complexes.

- a) $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ b) $[\text{Cr}(\text{NH}_3)_2\text{CO}_3]\text{Cl}$
c) $[\text{Cr}(\text{en})_3]\text{Cl}_3$ d) $\text{NH}_4[\text{Cr}(\text{H}_2\text{O})_2(\text{NO}_3)_4]$
6. a) Define transition elements and write their general outer electronic configurations. [2]
b) Give reasons for the following [6]
i) Transition element complexes are coloured
ii) Transition elements are suitable for complex formation
iii) Transition element compounds are paramagnetic
7. a) Define hybridization. Give the scheme of hybridization in SF_6 molecule and also predict its geometry. [1+3]
b) Explain the formation of H_2 molecule on the basis of VBT. [2]
c) What are silicones? Write some important uses of it. [2]

Group C

8. What does SN^2 represent? Explain its chemical reaction mechanism with a suitable example. Write a suitable chemical reaction that represents E_1 , E_2 , SN^1 and pinacol pinacolone rearrangement reaction. [4+4]

OR

Write the difference between addition reaction and elimination reaction. Explain the chemical reaction mechanism of E^1 and give reason why SN^1 is said to represent unimolecular nucleophilic substitution reaction. [3+5]

9. a) What is geometrical isomerism? Write the necessary conditions for a compound to show geometrical isomerism. [1+2]
b) Taking an example of organic compound, show enantiomers, diastereomers and meso compounds giving reasons. [3]
c) Write the general characteristics of enantiomers. [2]
10. a) How is TNG prepared? Write its uses. [2+1]
b) Differentiate thermosetting and thermoplastic polymer with suitable example. [2]
c) What is the role of Grignard reagent in the preparation of 1°, 2° and 3° alcohol? [3]

Exam	Back		
Level	BE	Full Marks	80
Programme	BCE, B.Agr.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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- Write the value of four quantum numbers for the last electron of sodium. [2]
 - Derive Schrodinger wave equation and mention its implication. [5+1]
- What is pH scale? Write its limitation. [3+1]
 - 400CC of 0.2M CH_3COOH is mixed with 100CC of semimolar NaOH solution. Calculate the pH of the mixture. [K_a of $\text{CH}_3\text{COOH} = 1.8 \times 10^{-5}$] [4]
- What is standard hydrogen electrode? Give the cell notation of Cu electrode with it. [3+1]
 - The EMF of the combination of given electrode [4]
 - $\text{AgCl} + e^- \rightarrow \text{Ag} + \text{Cl}^-$ $E = -0.2\text{V}$
 - $\text{Cu} \rightarrow \text{Cu}^{++} + 2e^-$ $E = +0.34\text{V}$

is 0.09. Calculate the concentration of Cu^{++} ion in electrode b, where a is in standard condition.
- Derive the equation which shows that how the heat of reaction depends upon the temperature. Calculate the heat of formation of glucose if enthalpy of combustion of glucose is -2808 KJ , amount of heat evolved by the burning of 1 mole of charcoal is 394 KJ and heat of formation of water is -286 KJ . [4+4]

OR

Write short notes on:

- Bomb calorimeter
 - 1st law of thermodynamic
5. a) Give the chemical formula for the following compounds. [2]
- Diammine silver (I) iodide
 - Pentammine monochlorocobalt (III) Chloride
 - Hexaqua iron (III) chloride
 - Potassium tetraiodo mercurate (II)
- b) Give the postulates of Werner's theory of complexes and mention the key point to distinct primary and secondary valencies to central metal atom/ion in a complex with example. [4+2]

OR

- Give the postulates of valence bond theory of complexes. [4]
- Predict the geometry and magnetic character of $[\text{Ni}(\text{CN})_4]^{--}$ and $[\text{Ni}(\text{CO})_4]^0$ according to the same theory. [4]

6. a) What are hybrid orbitals? Explain the geometry of NH_3 and PCl_5 on the basis of hybridization. [1+5]
b) What are silicones? Give the four main properties of silicones. [2]
7. a) Write down the characteristics of transition metal. [2]
b) Explain the characteristics of 3d transition metals with reference to (i) variable oxidation state (ii) complex formation. [6]
8. a) In which aspect the aquenhydrolysis of methyl bromide differs from aqueous hydrolysis t-butyl bromide. [4+4]

OR

- a) Explain E_1 and E_2 mechanism with suitable examples. [3+2]
b) Why rearrangement reaction differs from addition one. [2+1]
9. a) What is the minimum requirement for an organic molecule to represent its and trans isomerism? Explain it with suitable example. [2]
b) Explain diastereomers, enantiomers and meso compound with suitable examples. [6]
10. a) How you will obtain [3]
i) Butanol and
ii) Pentanol from propyl magnesium bromide and benzoic acid from toluene
b) Give the chemistry of TNT. [2]
c) Terylene and Telfon are different polymer, explain it. Give the preparation and property of Nylon 66. [1+2]
