

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

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

Subject: - Engineering Chemistry (SH 403)

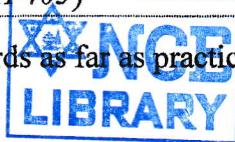
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. What is single electrode potential? How is it originated? Illustrate it with zinc electrode. [1+2+2]
2. Derive Henderson's equation for basic buffer. The pH of a buffer solution containing 0.1 M CH_3COOH and 0.1 M CH_3COONa is 4.74. If 0.05 mole of HCl is added to one litre of this buffer solution. What will be the pH? (K_a of $\text{CH}_3\text{COOH} = 1.8 \times 10^{-5}$). [2+3]
3. Write about the different types of catalysts. Explain the adsorption theory of Catalysis using suitable example. [2+3]
4. How can a constant layer of ozone be naturally maintained in the stratosphere? Why is ozone layer indispensable for the existence of living beings? Explain how the use of chlorofluorocarbon has caused the depletion of ozone layer. [1+1+3]
5. What are water pollutants? Write the major sources, effects and remedies of water pollution. [1+4]
6. Distinguish between organic and inorganic polymer. Write the preparation and uses of Polymeric Sulphur (PS_n) and Polythiazyl. [2+3]
7. What is FRP? Write down the preparation and uses of Teflon and Nylon 6,6. [1+2+2]
8. What are transition elements? Explain the colour formation and variable oxidation states of transition elements. [1+2+2]
9. Explain. Why (i) TiO_2 is colorless but TiCl_3 is not. (ii) Cu^+ is diamagnetic whereas Cu^{++} is paramagnetic. [2.5+2.5]
10. How does double salt differ from complex salt? Draw the structure of $\text{K}_4[\text{Fe}(\text{CN})_6]$ using Werner's postulates. Write the IUPAC name of the following: [2+1+2]
 - i) $[\text{Ni}(\text{CN})_4]^{2-}$
 - ii) $\text{K}_2[\text{ZnCl}_4]$
 - iii) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$
 - iv) $\text{Na}_3[\text{Al}(\text{C}_2\text{O}_4)_3]$
11. Define complex compound. Explain the formation of $[\text{Ni}(\text{CO})_4]$ and $[\text{Fe}(\text{CN})_6]^{3-}$ on the basis of VBT. Also mention the magnetic property and geometry. [1+2+2]
12. What low explosive? Write the preparation and important uses of the explosives obtain from toluene and glycerol. [1+2+2]
13. a) List out the functions of lubricants. Explain solid lubricant with examples. [2+1+2]
 - b) What are the requisites of a good paint?
14. a) What isomerism is shown by butenedioic acid and why? [2+3]
 - b) Distinguish between enantiomers and diastereoisomers with a suitable examples.
15. Explain the reaction mechanism of hydrolysis of tert-butyl bromide. How does SN_1 differ from SN_2 reaction? [3+2]
16. Explain the Saytzeff's rule with an example. Write the reaction mechanism of dehydrohalogenation of tertiary alkyl halide. [2+3]

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1. Explain the principle involved in the construction of galvanic cell. Draw the cell diagram and calculate the emf of following cell at 25°C. (Given: $E^\circ Al^{3+}/Al = -1.66$ V and $E^\circ Cu^{2+}/Cu = 0.34$ V)
 - $Al(s) / Al^{3+} (0.75\text{ M}) \parallel Cu^{2+} (0.50\text{ M}) / Cu(s)$ [2+3]
2. Give an example of a buffer solution with a pH less than 7 and show how it resists the PH change on addition of small amount of acid or base?
100 ml of 0.2 M acetic acid solution is mixed with 300 ml of 0.3 M sodium acetate solution. Calculate the pH of resulting mixture. ($pK_a = 4.74$) [2.5+2.5]
3. What is meant by homogenous catalysis? Explain the adsorption theory of catalysis with suitable example. [1+4]
4. What does a primary pollutant mean? What are the harmful effects of CO on human being? What is the difference between good ozone and bad ozone? [1+2+2]
5. a) Define the terms BOD and COD.
b) Define soil pollution. What are the causes of soil pollution? [2+1+2]
6. What are the general characteristics of inorganic polymer? Write the preparation and uses of chalcogenide glasses. Also mention two uses of silicones. [2+2+1]
7. Define the term biodegradable polymer with suitable example. Write down the preparation and application of Teflon and polyurethane. [1+2+2]
8. Why does d-block element is called transitional element? Describe the 3d series elements on the basis of color formation and variable oxidation state. [1+2+2]
9. Explain the variation of ionization potential across the 3d series of elements. Why are copper (II) complexes paramagnetic but copper (I) complexes diamagnetic? [2+3]
10. Write the postulates of Werner's coordination theory. Show the Werner's representation of $Co(NH_3)_4\text{Cl}_2$ and $Co(NH_3)_5\text{Cl}$. Write the IUPAC name of following complexes:
(i) $Na_4[Fe(CN)_6]$ (ii) $[Ag(CN)_2]^-$ [2+2+1]
11. Explain on the basis of valence bond theory- $[Co(NH_3)_6]^{3+}$ is diamagnetic but $[Cu(NH_3)_6]^{2+}$ is paramagnetic. [2.5+2.5]
12. What are plastic explosives? Write the preparation and uses of trinitrotoluene (TNT) and Gun cotton. [1+2+2]
13. a) What are the requisites of a good paint? Write the uses of emulsion.
b) What is the purpose of lubrication? Mention the conditions at which the solid lubricants are used. [2.5+2.5]
14. a) Explain the condition required for optional activity of a molecule. Explain the stereoisomeric forms of 3-bromo-2-butanol.
b) Write the cis and trans isomers of butene dioic acid. [1+2+2]
15. Explain the reaction mechanism for the hydrolysis of tertiary alkyl halide by aqueous NaOH. How the nature of solvent governs S_N1 and S_N2 reaction? [3+2]
16. What is elimination reaction? Discuss the mechanism of E2 reaction. Write your acquaintance with Sayrzeff's rule. [1+2+2]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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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.
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1. 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) $\text{Sn}^{++}(0.3\text{M}) + 2e = \text{Sn}, E^0 = -0.14\text{V}$
2. Could you prepare the acidific buffer of pH =1? Why and how? Calculate the pH of mixture obtained by mixing 50cc of 0.5N NH₄OH and 100cc of 0.2M NH₄Cl solutions. ($K_b = 1.8 \times 10^{-5}$) [2+3]
3. What are the characteristics of Catalysts? Explain their activity on the basis of adsorption theory of catalysis. [2+3]
4. a) Why are the oxides of sulphur called air Pollutants? [2]
 - b) Mention the sources and consequences of greenhouse effect. [3]
5. What are the effect of soil pollution in agriculture and living beings? How is soil pollution controlled? [3+2]
6. How do you prepare polythiazyl? Mention the applications of polyphosphazines and chalcogenide glasses in engineering field. [2+3]
7. Discuss about the conducting polymers. Write the preparation and uses of Teflon and epoxy resin. [1+4]
8. 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]
9. Explain the followings: [2×2.5]
 - a) Presence of the unpaired electrons makes substance paramagnetic.
 - b) Variable oxidation states are the main characteristic of transition elements.
10. a) Differentiate between double salt and complex salt with examples. [3]
 - b) Write the IUPAC names of the followings: [2]
 - (i) $\text{Na}_4[\text{Fe}(\text{CN})_6]$
 - (ii) $[\text{Zn}(\text{OH})_4]^{2-}$
 - (iii) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
 - (iv) $[\text{Co}(\text{en})_2\text{Cl}_2]^+$
11. 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]
12. 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]
13. a) Explain the mechanism for reaction between tertiary butyl bromide with aqueous KOH. [3]
 - b) How does SN₂ reaction differ from SN₁ reaction? [2]
14. What is Saytzeff's rule? Explain it with an example. Explain the reaction mechanism for the dehydrohalogenation of tertiary alkyl halide. [2+3]
15. Give an account of low and high explosives. Write the preparation and uses of TNT. [3+2]
16. 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
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Examination Control Division
2078 Kartik

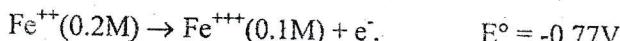
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1. What is Daniel cell? Calculate the emf of the following combination.

[1+4]



2. Derive Henderson equation. To 1 liter of buffer solution containing 0.1M NH₄OH and 0.2M NH₄Cl, if 0.2 g of NaOH is added, what will be the pH of the resulting solution? [pK_b=4.74].

[2+3]

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 [NiCl₄]²⁻ and [Ni(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 co-ordination compounds with an example.

[1+2]

- b) Name the following complexes by IUPAC system.

[4×0.5]

- (i) [Co(NH₃)₅SO₄]Br
- (ii) [Co(en)₃]Br₃
- (iii) K₃[Cr(NO₃)₆]
- (iv) [Ni(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 S_N2 and S_N1 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]

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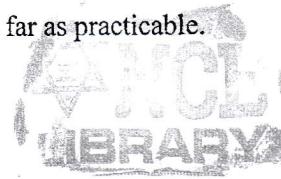
1. What is normal hydrogen electrode? How do you measure standard reduction potential of zinc electrode? Calculate the emf of the cell at 25°C, Ni/Ni⁺(0.8M) // Ag⁺(0.2M) / Ag
Given, E° Ni/Ni⁺ = +0.25V, E° Ag/ Ag⁺ = -0.80V. [1+1+3]
2. Explain the mechanism of basic buffer. Calculate the PH of the resulting buffer solution containing 100ml of 0.5M NH₄OH and 40ml of 1 M NH₄Cl in which 20cc of 0.5HCl is added. [2+3]
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]
4. What are the main sources of water pollution? Mention the measures to control water pollution. [2+3]
5. What is meant by ozone depletion? Write consequences of global warming and its possible remedies. [2+3]
6. What are biodegradable polymers? Write down the preparation and uses of Bakelite and Epoxy resin. [1+2+2]
7. What are polyphosphazenes? How are different types of polyphosphazenes prepared? Mention the applications of polythiazyl in engineering field. [1+3+1]
8. Variable oxidation state is the main characteristics of transition elements, explain with reference to 3d series. [5]
9. Explain the followings.
 - i) Mn⁺² is more paramagnetic than Cu⁺².
 - ii) Zn⁺² compounds are white while Fe⁺² compounds are colored.
 - iii) Transition elements from alloys. [2+2+1]
10. a) Differentiate between double and complex salts. Predict the magnetic properties of [Co(NH₃)₆]Cl₃ with the help of EAN. [2+1]
- b) Write the IUPAC name of the followings:
 - (i) Na₃[Al(C₂O₄)₃]
 - (ii) [C₆(NH₃)₄Cl₂]Cl
 - (iii) [Cr(NH₃)₆]³⁺
 - (iv) [Zn(OH)₄]²⁻
[2]
11. With the help of VBT approach, point out the differences between [Fe(CN)₆]⁴⁻ and [FeF₆]³⁻ complex ions. [2.5×2]
12. a) Show your acquaintance with liquid and semi liquid lubricants. [2.5]
- b) What do you understand by paints? Mention the requisites of a good paint. [2.5]
13. What isomerism is shown by tartaric acid and why? Write the possible forms of tartaric acid and mention enantiomers and mesocompound. [5]
14. What is SN reaction? Explain the reaction mechanism of hydrolysis of tertiary alkyl halide by aqueous NaOH. [1+4]
15. Describe the mechanism of E¹ reaction with suitable example. Give an account of Sayteff's rule. [4+1]
16. What are primary and low explosives? Write the preparation and uses of TNT and TNG. [5]

TRIBHUVAN UNIVERSITY
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2076 Ashwin

Exam.	Back		
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Year / Part	I/I	Time	3 hrs.

Subject: - Engineering Chemistry (SH 403)

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1. 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]
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]
3. Differentiate between negative catalysis and catalytic poisoning. How a catalyst work and what is the role of promoter? [2+2+1]
4. What are the primary and secondary air pollutants? Describe with examples. What is acid rain and how does it occur? [2+1+2]
5. What is water pollution? What are the major pollutants that should be monitored in order to explain the drinking water quality? [1+4]
6. a) How do you differentiate a double salt from a complex? Explain with examples. [2]
b) Write the IUPAC name and calculate the effective atomic number of following complexes.
(i) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ (ii) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ (iii) $[\text{Al}(\text{OH})(\text{H}_2\text{O})_5]^{2+}$ [3]
7. 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]
8. Give the reasons for:
a) Cu^+ compounds are diamagnetic where as Cu^{++} compounds are paramagnetic.
b) Ti^{+++} compounds are colored where as Ti^{++++} compounds are colorless. [2.5+2.5]
9. What are transition elements? Why are they called so? Why do transition elements form complex. [1+1+3]
10. Define the following terms: [1×5]
a) Primary explosives b) Secondary explosives c) Tertiary explosives
d) Low explosives e) High explosives
11. 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 plan 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 polyphosphazine. 'The SN^1 reaction gives both retention and inversion product but SN^2 reaction gives inversion product.' Explain. [2+3]
16. What do you mean by elimination reaction? Explain the reaction mechanism of E1 reaction. [2+3]

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1. 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°_{Cr/Cr}⁺⁺⁺ = 0.75V and E°_{Fe⁺⁺/Fe} = -0.44V.

[1+1+3]

2. 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]

3. Define catalytic promoter and catalytic poison. Explain the adsorption theory of catalysis with a suitable example.

[2+3]

4. Write down the major water pollutants and their harmful effects on mankind. Mention their possible remedies.

[5]

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]

(6) 6. Write down the preparation of polymeric sulphur nitride. Mention the engineering applications of polymeric sulphur nitride and chalcogenide glass.

[2+3]

7. What are biodegradable and non biodegradable polymers? Mention the applications of Bakelite and epoxy resin.

[2+3]

8. What are transition elements? Explain the colour of transition elements on the basis of d to d transition.

[1+4]

9. 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]

10. 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+2.5]

11. 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+2.5]

12. What are high and low explosives? Write the important uses of TNT and TNG.

[2+3]

13. 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+2.5]

14. What is optical isomerism? Show all the possible stereoisomers of tartaric acid indicating enantiomers and meso-forms.

[1+4]

15. Explain why S_N¹ reaction gives the products with both retention and inversion of configuration but S_N² gives only inversion of configuration. Write the mechanism of reaction between tertiary alkyl halide and aqueous sodium hydroxide.

[2+3]

16. Explain the mechanism of E¹ reaction with a suitable example. Write the differences between E¹ and E² reactions mechanism.

[3+2]

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1. 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, pKa for acetic is 4.74. [2+3]
2. a) What is meant by single electrode potential? How does it originate? What are the factors affecting the single electrode? [1+1+1]
 b) Calculate the emf for the following cell at 25°C, [2]

$$\text{Sn(s)/Sn}^{2+}(0.15\text{M})//\text{Ag}^+(0.03\text{M})/\text{Ag(s)}, \text{Where } E^0_{\text{Sn}^{2+}/\text{Sn}} = -0.14\text{V} \text{ &} \\ E^0_{\text{Ag}^+/\text{Ag}} = +0.80\text{V}$$
3. 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]
4. What are different water pollutants? Mention the different sources of water pollution, their adverse effects and possible remedies. [1+2+1+1]
5. a) How is ozone formed and depleted in nature? What are the consequences of depletion of ozone layer in the atmosphere? [2+1]
 b) Describe the adverse effects of air pollutants and their possible remedies. [2]
6. What is biodegradable polymer? Mention preparations and use of the following. [1+2+2]
 - Polyurethane
 - Nylon-6,6
7. What is conducting polymer? Give the preparation and applications of: [1+2+2]
 - Polyphosphazenes
 - Polymeric Sulphur nitride (SN_n)
8. Explain the following features of transition elements with reference to 3-d transition series (i) Alloy formation (ii) Complex formation. [2.5+2.5]
9. 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
10. Show your familiarity with double salt, complex salts and ligands. How does Werner's theory explain the structure of complex compounds? [3+2]

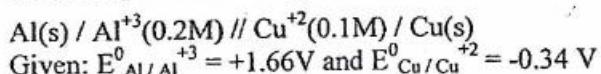
11. a) Using valence bond theory, predict the geometry and magnetic properties of $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{Co}(\text{NH}_3)_6]^{3+}$ [1.5+1.5]
- b) Write the IUPAC names of the following co-ordination compounds. [2]
- $[\text{Na}_3\text{Al}](\text{C}_2\text{O}_4)_3$
 - $[\text{Co}(\text{NH}_3)_2(\text{en})_2]\text{Cl}_3$
 - $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$
 - $[\text{Al}(\text{OH})(\text{H}_2\text{O})_5]^{2+}$
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, diasteromers, racemic mixture and meso compound with a suitable example of each. Also write their optical activity. [5]
16. Give an account of SN reactions. Explain the reaction mechanism for the reaction between 3° alkyl halide and aqueous NaOH. [2+3]

Exam.	Back		
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 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.



[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]

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?

7. Q) What are transition elements? Which of the d-block elements are not considered as

b) Write the electronic configuration and group of the following elements Cr, Fe, Cu and typical elements and why? [1+2]

$\text{Ti}^{(\text{Cp})_2\text{I}_3}$ and $[\text{FeF}_6]^{3-}$ both are octahedral complexes. Explain the difference between

these two complexes on the basis of VBT. [5]

a) How do you distinct a double salt from a complex salt?

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

(j) $[\text{Co}(\text{H}_2\text{O})_7(\text{OH})_4]^-$

(ii) $[\text{Ni}(\text{CN})_4]^{2-}$

(iii) $K_3[Al(C_2O_4)_3]$

(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]

- K N G*
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 diasteromers? 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.	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. 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]

$$\text{Zn/Zn}^{++}(0.1\text{M})//\text{Cu}^{++}(0.05\text{M})/\text{Cu}$$

Given, $E^{\circ}\text{Zn}^{++}/\text{Zn} = -0.76\text{V}$ $E^{\circ}\text{Cu}^{++}/\text{Cu} = 0.34\text{V}$
2. a) How does an acidic buffer solution containing acetic acid and sodium acetate resist the change in pH in spite of the addition of the small amount of acid or base? Explain it. [2]
- b) Calculate the pH of resulting solution when 0.01 mole of NaOH is added to 500ml of 0.1M acetic acid (p_{ka} for acetic is 4.74) [3]
3. What is homogeneous catalyst? How does a catalyst alter the rate of reaction? Explain with example. [1+4]
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]
5. Write short notes on: [2.5+2.5]
 - i) Ozone layer depletion
 - ii) Global warming due to air pollution
6. What is conducting polymer? Describe the preparation and uses of polyurethane and Epoxy resin. [1+2+2]
7. a) Write down the structure of cyclic and cross linked silicones and also give the engineering applications of silicones. [1+1]
- b) What are the general characteristic of inorganic polymer? Write the preparation and uses of polymeric sulphur. [1+2]
8. Give reasons: [5]
 - a) Transition elements are mostly paramagnetic
 - b) Transition elements and their compounds show catalytic behavior
 - c) $\text{Fe}_2(\text{SO}_4)_3$ is more stable than FeSO_4
 - d) Compound of Ti^{+3} are coloured but those of Ti^{+4} are colourless
 - e) 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-chlori pent 2-ene. [3+2]
15. Describe the bimolecular nucleophilic substitution reaction in haloalkane with suitable example. What type of solvent is favour for this reaction? Write down the differences between S_{N}_1 and S_{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.	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]

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

$$[\text{Fe}^{++}] = 0.01M, \quad [\text{Ag}^+] = 0.1M$$
2. What is buffer capacity? Write the characteristics of buffer solution. 200 ml of 0.1M C₆H₅ COONa is mixed with 400 ml of 0.2 M C₆H₅COOHa 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:
 - i) Polyphosphazine
 - ii) 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 [NiCl₄]²⁻ and [Ni(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]
 - i) Potassium penta cyano nytrosyl ferate (III)
 - ii) Pentaammine chloro cobalt (III) ion
 - iii) Tetracarbonyl cobalt (O)
 - iv) Pentamminenitrito cobalt (III) sulphate
 b) "[Fe(CN)₆]⁴⁻ is diamagnetic but [Fe(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]

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Examination Control Division
 2073 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 Buffer. Write the mechanism of acidic buffer. Calculate the pH of the solution formed by adding 0.2 g of sodium acetate in 200 mL 0.1 M acetic acid. pKa for acetic acid = 4.74. [1+2+2]
2. What is standard hydrogen electrode? How is it used to measure the single electrode potential? Why is salt bridge used in construction of galvanic cell? Calculate the emf of the following cell at 25°C. [1+1+1+2]

$$[E^0_{Ni^{++}/Ni} = -0.24V \text{ and } E^0_{Pb^{++}/Pb} = -0.12V]$$

$$Ni(s)/Ni^{2+}(aq)(1M) // Pb^{2+}(aq)(1M)/Pb(s)$$
3. Explain with an example the mechanism of adsorption theory of catalysis. Write the differences between homogenous and heterogenous catalysis. [4+1]
4. Define soil pollution. Write the major sources of soil pollution, their negative effects and control measures. [1+2+2]
5. Write the formation, effects and remedies of SOx and NOx. [2.5+2.5]
6. What are biodegradable polymers? Give the preparation and uses of Nylon 6,6 and polyurethane. [1+2+2]
7. Describe the preparation and uses of polymeric sulphur (PS)_n and polyphosphazines. [2.5+2.5]
8. Give an account for the following: [1+1+3]
 - Cu²⁺ (3d⁹) is more stable than Cu⁺ (3d¹⁰). Justify the statement.
 - Why Zinc is called non-typical transition element?
 - Explain magnetic properties of transition elements.
9. Explain with reasons: [2.5+2.5]
 - Transition metals can form most of the complex compounds.
 - Zinc (II) compounds are white and diamagnetic while copper (II) compounds are colored and paramagnetic.
10. Explain the formation of [Co(NH₃)₆]³⁺ and [CoF₆]³⁻ on the basis of Valence Bond Theory and also predict their magnetic property. [2+2+1]
11. Write the basic assumptions of Werner's theory of co-ordination compounds. CoCl₃.4NH₃ gives a precipitate with AgNO₃ solution. Explain it on the basis of Werner's theory. [3+2]
12. What are plastic explosives? Write the advantages of plastic explosives. Write the preparation of TNT, TNG and nitrocellulose. [1+1+3]

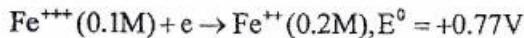
13. a) What are lubricants? Show your familiarity with application of different types of lubricants.
b) Explain the method of application of paints in galvanized iron. [1+2+2]
14. a) Explain geometrical isomerism with examples.
b) Write all possible stereoisomers of 2,3-dibromopentane. Identify all possible enantiomers and diastereomers from the stereoisomers. [1.5]
15. What are the differences between E¹ and E² reactions? Explain the reaction mechanism for the reaction of primary alkyl halide with alcoholic NaOH. [3.5]
16. Why does S_N¹ reaction give both retention and inversion isomers but S_N² gives only inversion isomer? Write the mechanism for the reaction between bromoethane and aq.NaOH. [2+3]

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. Derive the equation required to calculate the emf of cell at non-standard condition. What are the factors that affect the single electrode potential value? Calculate the oxidation electrode potential of given half cell reaction at 20°C. [2+1+2]



2. What are the criteria for buffer system? Calculate the change in pH of buffer system having 200 cc of 0.1 M CH₃COOH and 0.1 M CH₃COONa when 1 millimole NaOH is added into it. ($K_a = 1.8 \times 10^{-5}$) [2+3]

3. What is autocatalysis? Explain the mechanism of adsorption theory of catalysis with example. [1+4]

4. What are the major pollutants responsible for water pollution? How do the oxides of sulphur and nitrogen make water acidic? [2+3]

5. What is meant by ozone depletion? Write its causes and consequences. [2+3]

6. a) What are chalcogenide glasses? Give an account of preparation and uses of chalcogenide glasses in the engineering field. [1+2+2]

- b) Write down the preparation of cyclic silicones.

7. a) Give an account for the biodegradable and non-biodegradable polymers with suitable examples. [2.5×2]

- b) What are fibers-reinforced plastics? Write down its applications.

8. Explain the origin of the adsorption spectra of transition elements with d to d transitions. [5]

9. Mention the main applications of 3d elements and give main causes of variable oxidation states shown by transition elements. [3+2]

10. a) Describe the simple test to distinguish between the following pairs of compounds on the basis of Werner's theory. $[\text{Co}(\text{NH}_3)_5\text{Cl}] \text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4] \text{Cl}$ [2+2+1]

- b) Name the following complexes by IUPAC system.

- $\text{K}_3[\text{AlF}_6]$
- $[\text{Co}(\text{en})_3]\text{Br}_3$
- $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2$
- $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}_2$

- c) State EAN rule.

11. Using VBT, predict the possible number of unpaired number in the following complex compounds. $K_4[Fe(CN)_6]$ and $[FeF_6]^{3-}$ [2.5+2.5]
12. Write the mechanism for the conversion of Bromomethane into methanol in presence of aqueous alkali. Also explain the stereochemistry of the reaction. [3+2]
13. What do you mean by Elimination reactions? Explain the reaction mechanism for the dehydrohalogenation of tertiary alkyl halide. [2+3]
14. Write down the possible geometrical isomer of but-2-ene-1, 4-dioic acid. Why does this compound exhibit geometrical isomerism? Explain the difference between enantiomer and diastereoisomer giving an example of 3-bromo-2-butanol. [1+1+3]
15. What is the requisite of good explosive? How can you prepare TNT from benzene? Why does detonator required for the explosion of TNT? [2+2+1]
16. a) Show your acquaintance with liquid and semi-liquid lubricants. Under what situations greases are used? [3+2]
- b) What do you understand by paints? Mention the requisites of good paint.

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]

$$2\text{Al} + 3\text{ZnSO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + \text{Zn}$$
 at 298K
 (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 polyphosphazines 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 its properties. [1+2+2]

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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 buffer solution? Calculate the pH of 500 cc of 0.2 M CH_3COOH solution when 2 g of sodium acetate is added. [K_a for CH_3COOH is 1.8×10^{-5}] [1+4]
2. What is Daniell cell? Answer the following question using equation (a) and (b) [1+4]
 - (a) $\text{Fe}^{2+} (0.2\text{M}) = \text{Fe}^{3+} + \text{e} (0.1\text{M}), E^0 = -0.77\text{V}$, (b) $\text{Cu} (0.3\text{M}) - 2\text{e} = \text{Cu}^{2+}, E^0 = -0.34\text{V}$
 - (i) net cell reaction (ii) spontaneity of redox reaction (iii) cell notation (iv) emf of cell
3. What are catalytic promoter and catalytic poison? Explain their activity on the basis of adsorption theory of catalysis. [2+3]
4. a) What are chlorofluorocarbons? Explain their photolytic reactions in the upper atmosphere [3]
 - b) Discuss about the air pollution caused by oxide of nonmetals? [2]
5. What are the major water pollutants? Point out their adverse effect and the possible measures to control water pollution. [1+2+2]
6. Write the preparation and uses of Teflon and epoxy resin. What are conducting polymers? Point out their applications in engineering field. [3+1+1]
7. a) Give preparation and uses of the nonmetallic super conductor. [3+2]
 - b) Write down the main characteristic of inorganic polymers.
8. Give an account for the followings:
 - i) Transition metals are well known to form complexes. [2]
 - ii) Copper (I) compounds are white and diamagnetic whereas copper (II) compounds are colored and paramagnetic. [2]
 - iii) Zinc is nontypical transition metal. [1]
9. a) Explain the variable oxidation states of transition elements. Which divalent metal has maximum paramagnetic character among the first transition metals? [2.5+1+1.5]
 - b) A transition metal forms alloys with other transition metals easily. Why? Explain.
10. Explain how the two complexes of Ni, $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{Ni}(\text{CO})_4]^0$ have different structures but do not differ in their magnetic behavior ($\text{Ni} = 28$). [5]
11. a) Write the IUPAC name of the following compounds/ions [2+1+2]
 - I) $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$
 - II) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$
 - III) $[\text{Cr}(\text{en})_3\text{Cl}_2]^{+}$
 - IV) $\text{NH}_4[\text{Cr}(\text{H}_2\text{O})_5(\text{NCS})_4]$
 - b) What is complex compound? What do you understand by principal and auxiliary valency of the central ion in complex compound? Illustrate them in $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$.

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 2071 Shawan

New Back (2066 & Later Batch)			
Exam.	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 buffer solution? Calculate the pH of 500 cc of 0.2 M CH_3COOH solution when 2 g of sodium acetate is added. [K_a for CH_3COOH is 1.8×10^{-5}] [1+4]
2. What is Daniell cell? Answer the following question using equation (a) and (b) [1+4]
 - (a) $\text{Fe}^{++} (0.2\text{M}) = \text{Fe}^{+++} + e (0.1\text{M}), E^0 = -0.77\text{V}$, (b) $\text{Cu} (0.3\text{M}) - 2e = \text{Cu}^{+}, E^0 = -0.34\text{V}$,
 - (i) net cell reaction (ii) spontaneity of redox reaction (iii) cell notation (iv) emf of cell
3. What are catalytic promoter and catalytic poison? Explain their activity on the basis of adsorption theory of catalysis. [2+3]
4. a) What are chlorofluorocarbons? Explain their photolytic reactions in the upper atmosphere [3]

b) Discuss about the air pollution caused by oxide of nonmetals? [2]
5. What are the major water pollutants? Point out their adverse effect and the possible measures to control water pollution. [1+2+2]
6. Write the preparation and uses of Teflon and epoxy resin. What are conducting polymers? Point out their applications in engineering field. [3+1+1]
7. a) Give preparation and uses of the nonmetallic super conductor. [3+2]

b) Write down the main characteristic of inorganic polymers.
8. Give an account for the followings:
 - i) Transition metals are well known to form complexes. [2]
 - ii) Copper (I) compounds are white and diamagnetic whereas copper (II) compounds are colored and paramagnetic. [2]
 - iii) Zinc is nontypical transition metal. [1]
9. a) Explain the variable oxidation states of transition elements. Which divalent metal has maximum paramagnetic character among the first transition metals? [2.5+1+1.5]

b) A transition metal forms alloys with other transition metals easily. Why? Explain.
10. Explain how the two complexes of Ni, $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{Ni}(\text{CO})_4]^0$ have different structures but do not differ in their magnetic behavior ($\text{Ni} = 28$). [5]
11. a) Write the IUPAC name of the following compounds/ions [2+1+2]
 - I) $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$
 - II) $[\text{Fe}(\text{C}_2\text{O}_4)]^{3-}$
 - III) $[\text{Cr}(\text{en})_3\text{Cl}_2]^{+}$
 - IV) $\text{NH}_4[\text{Cr}(\text{H}_2\text{O})_5\text{NCS}]_4$
b) What is complex compound? What do you understand by principal and auxiliary valency of the central ion in complex compound? Illustrate them in $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$.

12. a) What are lubricating oils? Indicate its application in engineering work. [1+2]
b) Show your familiarity with the types of paint. [2]
13. a) Write the difference between enantiomers and diasterioisomers giving appropriate examples. [3+2]
- b) Write Cis, Trans and Z, E notations for the possible isomers of but-2-endioic acid.
14. a) Explain the mechanism involved in the reaction between bromomethane and aqueous NaOH. [3]
b) How do nucleophile and solvent affect this type of reaction? [2]
15. a) Differentiate between E¹ and E² reaction. [2+3]
b) Explain the reaction mechanism for the dehydrohalogenation of 3° alkyl halide.
16. What are low explosives? Write the preparation and uses of GTN and TNT. [1+4]

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. What is SHE? Calculate the emf of electrode couple of $E^\circ_{\text{Sn}/\text{Sn}^{+2}} = -1.4\text{V}$ and $E^\circ_{\text{Fe}^{+2}/\text{Fe}^{+3}} = -0.77\text{V}$. Where the concentration of Sn^{+2} , Fe^{+2} and Fe^{+3} are 0.2M 0.1M and 1 M respectively. [2+3]
2. Explain the mechanism of buffer action with a suitable example. Calculate the weight in gram of NH_4Cl required to prepare buffer solution having $\text{pH} = 9.35$ in 200 cc of 0.2N ammonia solution. ($\text{pK}_b = 4.74$) [3+2]
3. What is heterogeneous catalysis? How does a catalyst alter the rate of reaction? Give a brief account on the intermediate compound formation theory of catalysis. [1+1+3]
4. a) What is ozone depletion? Write the chemical reactions involved in the stratospheric ozone depletion by nitric oxide? [1+2+2]
 - b) How does carbon dioxide cause atmospheric pollution?
5. What are the major water pollutants and their harmful effect? Mention the possible measures to control water pollution. [2+3]
6. a) Write the engineering applications of Silicone and give the structure of cyclic and cross linked silicones. [3+2]
 - b) Write the preparation of polyphosphazine and its uses.
7. What are biodegradable polymers? Write down the preparation and uses of Nylon 6.6 and Teflon. [1+4]
8. a) Why do transition metals form complex compound? [3+2]
 - b) Explain why the 3d transition series having completely filled d-orbital cannot form coloured compounds.
9. What are transition elements? Why does the presence of unpaired electrons make a substance paramagnetic in nature? Explain it with magnetic moment measurement. [1+4]
10. Name the following complexes by IUPAC system: [2+3]
 - i) $[\text{Cr}(\text{H}_2\text{O})_4(\text{NH}_3)_2]\text{Br}_3$
 - ii) $[\text{CuCl}_2(\text{CH}_3\text{NH}_2)_2]$
 - iii) $\text{Ni}[\text{PtCl}_6]$
 - iv) $[\text{Cr}(\text{NH}_3)_6]^{3+}$

State and explain EAN rule as applied to metal complexes.
11. Differentiate between inner and outer orbital complexes. Magnetic measurement on $\text{K}_3[\text{Fe}(\text{CN})_6]$ indicates the presence of one unpaired electron, predict on the basis of VBT whether the given complex is inner or outer complex. [2+3]

12. Define explosives. Why are the primary explosives called "detonators"? Write the reaction of toluene forming an explosive. Mention the important uses of GTN and plastic explosives.[1+1+1+2]
13. a) What are solid lubricants? Mention the types and function of lubricants with examples.[1+2+2]
b) Explain the method of application of paint in galvanized iron.
14. a) What isomerism is shown by tartaric acid and why? [2+3]
b) Define enantiomers with examples. Differentiate between racemic mixture and mesocompound.
15. Explain the reaction mechanism for the hydrolysis of tertiary alkyl halide by aqueous NaOH. What solvent favours the reaction mechanism? [4+1]
16. What is Saytzeff's rule? Describe the mechanism for the reaction of 3°alkyl halide in alcoholic alkali. [2+3]

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 buffer and buffer capacity? To 100 ml of 0.1 M acetic acid, 0.1 gm of sodium hydroxide is added. Find the pH of the resulting solution. (pK_a for acetic acid is 4.74) [2+3]
2. How does a galvanic cell differ from an electrolytic cell? Calculate the EMF of the cell: Zn/Zn^{++} (0.001M) // Ag^+ (0.1M) / Ag. The standard potential of Ag/Ag^+ half cell is 0.080 V and Zn/Zn^{++} is - 0.76 V [2+3]
3. a) What are promoters? Mention the action of promoters. [1+1]
b) Describe the adsorption theory of catalysis with a suitable example. [3]
4. a) Write down the sources and defects of sulphur oxides. [3]
b) Explain the causes and effects of ozone layer depletion. [2]
5. What are the major water pollutants and their harmful effect? Mention the possible measures to control water pollution. [3+2]
6. Write short notes on (i) Sulphur based polymers (ii) Chalcogenide glass. [3+2]
7. a) Give preparation and uses of Nylon.6,6 and polyurethane. [4]
b) What are engineering applications of conducting polymer? [1]
8. a) Write the important characteristics of transition elements. [2.5]
b) Explain the magnetic properties of the transition elements. [2.5]
9. Explain the following: [2.5+2.5]
a) Complexes of transition elements are generally coloured.
b) Most of the transition elements are paramagnetic.
10. What are primary and secondary valencies of metal? Explain the structure of $K_4[Fe(CN)]_6$ on the basis of Werner's theory. [2+3]
11. a) With the valence bond concept, explain the geometry and magnetic character of the complex $[Ni(CO)_4]$. Write down one of the limitations of valence bond theory. [2+1]
b) Write the IUPAC name of the following co-ordination compounds. [2]
i) $K_2[PtF_6]$
ii) $K_3[Al(C_2O_4)_3]$
iii) $[Co(NH_3)_5SO_4] Br$
iv) $[Pt(NH_3)_4Cl_2] SO_4$
12. Explain the reaction mechanism for the hydrolysis of tertiary butyl bromide by aqueous NaOH. Differentiate between SN^1 and SN^2 mechanism. [3+2]
13. a) How do enantiomers differ with diastereoisomers? Illustrate with an example. [1+2]
b) What isomerism is shown by 2-bromo 1-chloropropene? Mention Z and E notation for the compound. [2]
14. What are secondary explosives? Give preparation and properties and uses of GTN and TNT. [2+3]
15. What do you mean by Elimination reactions? Explain the reaction mechanism for the reaction between primary alkyl halide and alcoholic NaOH. [2+3]
16. a) What are lubricating oils? Indicate their importance. [1+2]
b) Show your familiarity with types of paints. [2]

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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. 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^{-5} . [1+4]
2. 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 $[Zn^{2+}] = 1.0$ M, calculate H^+ in hydrogen electrode. [2+3]
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]
4. 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]
5. Write major sources of water pollution. How does CO_2 act as pollutant of the atmosphere? Explain. [2+3]
6. Give an account on chalcogenide glasses and polysulphur nitride. [2.5+2.5]
7. Explain about the biodegradable and non-biodegradable polymers with suitable examples. [2.5×2]
8. 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]
9. Transition elements formed colored compounds. Explain this on the basis of d to d transition. [5]
10. Compare the magnetic behavior of the complex entities $[Fe(CN)_6]^{4-}$ and $[FeF_6]^{3-}$ using valence bond theory. [2.5+2.5]
11. 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. [2+1+2]
- b) Mention the types and functions of lubricants with examples. [2]
13. a) What isomerism is shown by lactic acid? Write its possible isomers.
- 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]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME	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.

1. What is meant by buffer capacity? A chemist desires to prepare one liter of a solution buffered at pH 9.00. How many grams of ammonium chloride have to be added to one liter of 0.20M NH₃ to make such buffer. pKa value of ammonia is 4.75 [1+4]
2. How does an electrolytic cell differ from a galvanic cell? Calculate the emf of the cell. Zn/Zn²⁺(0.001M)//Ag⁺(0.1M)/Ag. The standard potential of Ag/Ag⁺ half cell is +0.80V and Zn/Zn²⁺ is -0.76V [2+3]
3. Explain the terms: (a) Heterogeneous catalysis (b) Catalytic poisoning and promoters. [2+3]
4. What is meant by ozone depletion? Mention its causes and consequences. [2+3]
5. What are the major water pollutants and their harmful effects? Mention the possible measures to control water pollution. [2+3]
6. Write short notes on: (a) Polyphosphazines (b) Chalcogenide glasses. [3+2]
7. a) Give an account for the biodegradable and non-biodegradable polymers with suitable examples. [2.5×2]
 - b) What are fiber-reinforced plastics? Write down the applications. [2.5×2]
8. What are transition elements? Point out the applications of these elements and their complexes. [5]
9. Compare ionisation potential and oxidation state of transition elements with representative elements. What is the effect of lanthanide contraction in properties of transition elements? Explain how colour is originated in transition metal complexes. [1+1+1+2]
10. Write assumptions of valence bond theory of complexes. Explain formation of spin paired complex on the basis of this theory. Mention its magnetic behaviour. [2+2+1]
11. What is a Chelate complex? Show Werner's representation and IUPAC name of the following complexes. (a) [Cu(NH₃)₄]SO₄ (b) K[PtCl₅(NH₃)] [1+2+2]
12. Give an account of low and high explosives. Write the preparation and uses of TNA. [3+2]
13. a) Show your acquaintance with lubricants? Under what situations greases are used? [3+2]
 - b) What do you understand by paints? Mention the requisites of a good paint.
14. a) What isomerism is shown by butenedioic acid and why? [2+3]
 - b) Define enantiomers with examples. Differentiate between racemic mixture and meso-compound.
15. Explain the reaction mechanism for the hydrolysis of 3° alkyl halide by aqueous NaOH. What solvent favours the reaction mechanism? [4+1]
16. What do you mean by Elimination reactions? Explain the reaction mechanism for the dehydrohalogenation of tertiary alkyl halide. [2+3]

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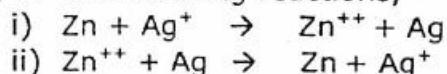
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

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,



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

[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]

[2]

11. a) Write the IUPAC name of following;

- 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		
Level	BE	Full Marks	80
Programme	BCE, BME	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 meant by normal hydrogen electrode? Calculate the emf of the following cell at 25°C $Mg|Mg^{++}(0.1M) // Ag^{+}(1M)/Ag$. Given $E^{\circ}Mg^{++}/Mg = -2.37V$, $E^{\circ}Ag/Ag^{+} = -0.80V$. [2+3]
 - Explain the mechanism of basic buffer. Write the equation for acidic buffer. 0.005gm equivalent of KOH is added to 400ml of 0.1N acetic acid, calculate the pH of the mixture. (K_a for acetic acid = 1.8×10^{-5}). [1.5 + 0.5+3]
 - Define heterogeneous catalysis. Point out some characteristics of catalytic reactions and mention its industrial application. [1+4]
 - a) Define soil pollution. What are its sources? [1+3]
b) Explain cause and effect of Ozone layer depletion. [4]
c) Give adverse effects of (i) pb (ii) phosphates in water. [2]
 - What are the general characteristics of inorganic polymer? What do you mean by cross linked? What are the engineering uses of chalcogenide polymer? [2+1+2]
 - Write short note on fibre reinforced resin. [5]
 - a) Explain variable oxidation states of transition metals, along with nature of oxides. [4]
b) Explain the colour of $[Ti(H_2O)_6]^{+3}$ ion. [4]
c) Transition metal complex ions with d^0 or d^{10} configuration are colourless. Why? [2]
 - a) Explain the formation of $[Ni(CO)_4]^{\circ}$ Complex on the basis of VBT. Also predict its geometry and magnetism with reason. [2+1]
b) Write the formula of the following co-ordination compounds. [0.5×4]
 - Dichloro-tetra-aqua chromium (III) cation
 - Dicyano argentate (I) ion
 - Sodium hexa nitrito cobaltate (III)
 - Hexa-cyanoferrate (III) ion
 - a) What are primary explosives and plastic explosives? Give the methods of preparation of TNT and uses. [1+1+3]
b) Explain lubricating oils with types. [3]
c) What are requisites of a good paint? [3]
 - a) Define: (i) Optical isomers (ii) Racemic mixture (iii) Chirality (iv) Optical activity. [4]
b) Get differences in between enantiomers and di-stereomers. [3]
c) How many meso-forms are possible for $CH_2OH (CHOH)_3 CH_2OH$? Write their Fischer projection. [2]
 - a) Define lubricant and lubrication and explain the main purpose of lubricant. [1+1]
b) What is paint? What are the requisites of a good paint? [1+2]
 - a) Describe the mechanism involved in the reaction between a tertiary alkylhalide and aqueous caustic potash. [1.5+1.5]
b) What type of solvent favours the unimolecular nucleophilic substitution reaction mechanism? What is meant by elimination reaction? [1+1]

11/ BCE

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Examination Control Division
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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.

Q 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]

Q $E^\circ \text{Zn}/\text{Zn}^{++} = 0.76\text{V}$, $E^\circ \text{Ag}^+/\text{Ag} = 0.80\text{V}$
 $[\text{Zn}^{++}] = 0.01\text{M}$, $[\text{Ag}^+] = 0.1\text{M}$

2. 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]
3. 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]
4. Write short notes on: (any two)
 - a) Green house effect
 - b) Formation and depletion of ozone layer
 - c) Acid rain[2.5+2.5]
5. List out four major pollutants of air, their adverse effects on human health and also write their possible remedies. [1+2+2]
6. Write the method of preparation and two important uses of each of polyurethane and diamine epoxy resin. [2.5+2.5]
7. What is biodegradable polymer? Describe the contribution of carbon fibre reinforced polymer and chalcogenide glass in engineering. [1+4]
8. a) What are transition elements? Which of the 3d series elements is not a transition element and why? [1+2]
b) Explain why compounds of V^{+5} are colourless but those of V^{+3} are colourful. [2]
9. a) Explain the cause of origin of paramagnetism in transition elements. [3]
b) Explain why are transition elements good for alloy formation. [2]
10. a) What is meant by effective atomic number of metal ion in the complex salt? What information does it convey? [2]
b) 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]
11. 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) $[\text{Co}(\text{NH}_3)_2(\text{en})_2\text{Cl}_3]^{2+}$
- 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]

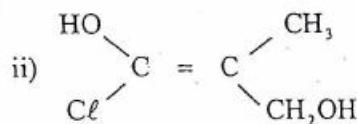
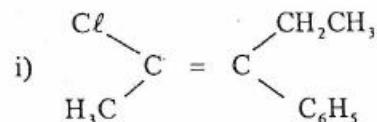
b) What is lubricant? Give an example of emulsion and solid lubricant. Mention their specific functions. [0.5+1+1]

14. a) Distinguish between enantiomers and diasteromers. 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]

801-1

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.

1. 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] 2

3. 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] 4

4. a) What are chlorofluorocarbons? Give their photolytic reactions in the upper atmosphere. [3]

b) Why oxides of sulphur and nitrogen are assumed as air pollutants? [2] 2

5. Point out four major pollutants of water, their adverse effect on human health and also mention their possible remedies. [2+1+2] 3

6. Describe the preparation and uses of polyphosphazines and polymeric sulphur (PS)n. [5]

7. What are double and complex salts? Write the formulae of the following co-ordination compounds. [2+3] 3

a) Dibromotetraaquochromium (III) chloride

b) Potassium hexacyanocobaltate (II)

c) Tetrabromocuprate (II)

d) Tetraamminedichlorocobalt (III)

e) Hexacyanoferrate (III) ion

f) Sodium trioxalato aluminate (III)

8. a) What are principal and auxiliary valencies of the metal ion in the complex compound? Illustrate them in $[Co(NH_3)_6]Cl_3$. [2]

b) Show your familiarity with electronic interpretation of complexes. [3]

Explain the followings:

a) Transition elements are good in forming complexes

b) Show your acquaintance with application of 3-d transition elements. [3+2] 4

10. What are transition elements? Explain the following features of transition elements; [1+2+2] 3

a) Variable oxidation state

b) Magnetic properties

- Ques*
11. Define explosives? Give the preparation, properties and uses of trinitrotoluene (TNT).
What are plastic explosives? [1+3+1] 4
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] 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 stereoisomerism. [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]
