| Exam. | | Regular | |
|---|---|---|---|
| Level | BE | **Full Marks** | 80 |
| **Programme** | BEL, BEX, BCT, BAME, BIE, BAG | **Pass Marks** | 32 |
| **Year / Part** | I / II | **Time** | 3 hrs. |

**Subject**: - Engineering Chemistry *(SH453)*

✓ 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 amount of sodium acetate in gram required to prepare a buffer solution having pH 5.1 with one liter of 0.2N acetic acid solution. Ka value of acetic acid is $1.8 \times 10^{-4}$.    [2+3]

2. Write the points of differences between electrolytic and galvanic cell. From the given information answer the following questions.

   $Ni \rightarrow Ni^{++} + 2e^{-}$       $E^0 = 0.24V$       $[Ni^{++}] = 0.1M$

   $Cd \rightarrow Cd^{++} + 2e^{-}$       $E^0 = 0.40V$       $[Cd^{++}] = 0.01M$    [2+3]

   a) Identify anode and cathode while constructing the galvanic cell with reasons.
   b) Write the symbolic representation of the galvanic cell when above given electrodes are coupled.
   c) Calculate the emf of the galvanic cell thus constructed at 25°C.

3. Define heterogeneous catalysis? Explain the absorption theory of catalysis with an example. List two criteria for choosing a catalyst for industrial purposes.    [1+3+1]

4. Point out the major water pollutants, their adverse effects and write its controlling measures.    [1+2+2]

5. What are the main gases responsible for causing greenhouse effect and how are they released into the atmosphere? Give an account to control the release of these gases.    [1+2+2]

6. Give an account of conducting and biodegradable polymers. Write down the preparation of epoxy resin. Point out the important applications of epoxy resin and nylon - 6, 6.    [2+1+2]

7. What are inorganic polymers? Give an account of chalcogenide glass and polythiazyl.    [1+2+2]

8. What are transition elements? Are all the d-block elements considered as typical transition elements? Justify your answer with reason.    [1+1+3]

9. Explain with reasons:

   a) Transition elements and their compounds show catalytic property
   b) Compounds of $Zn^{++}$ are colourless and diamagnetic but those of $Fe^{++}$ are coloured and paramagnetic    [2.5+2.5]

10. a) Differentiate between primary and secondary valencies in complexes.    [3]
    b) Write down the IUPAC name of the following complexes.    [2]

    i)   $K[Ag(CN)_2]$
    ii)  $[Fe(H_2O)_6]Cl_2$
    iii) $[Pt(NH_3)_2Cl_2]$
    iv)  $[Co(NH_3)_4Cl_2]^{+}$

11. In the given two complexes $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{2-}$ both have four co-ordination number but their geometries and magnetic properties are different. Justify these facts using VBT approach. [3+2]

12. What are primary and low explosives? Write the preparation and uses of Nitro cellulose. [2+3]

13. a) What are lubricating oils? Write the importance of lubrication in engine. [1+1.5]

    b) What are paints? Write the characteristics of good paints. [1+1.5]

14. a) What are geometrical isomers? What are the criteria for a compound to show geometrical isomerism? [1+1.5]

    b) Write the points of differences between enantionmers and diasteriomers with suitable example of each. [2.5]

15. Write the mechanism for the nucleophillic substitution reaction which takes place with only inversion of configuration. Write down the effect of substrate on the rate of $SN^1$ and $SN^2$ reactions. [3+2]

16. What do you mean by elimination reaction? Describe the mechanism for the reaction of 3° alkyl halide in alcoholic alkali. [1+4]

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| Exam. | | **Back** | |
|---|---|---|---|
| Level | BE | **Full Marks** | 80 |
| Programme | BEL, BEX, BCT, BIE, B. Agri., BAM | **Pass Marks** | 32 |
| Year / Part | I / II | Time | 3 hrs. |

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### Subject: - Engineering Chemistry (SH453)

✓ 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. a) What is standard hydrogen electrode? Give cell notation of cu electrode with it.

   b) From the given electrode couple $E^0_{Fe/Fe^{++}} = 0.44$ volt, $[Fe^{++}] = 0.5\,M$ and $E^0_{Ag/Ag^+} = -0.80$ volt, $[Ag+] = 0.2M$. Write the (i) electrode reaction (ii) net cell reaction (iii) cell notation (iv) EMF of Fe-Ag cell and spontaneity of the cell reaction.   [2+3]

2. a) What is buffer action? Describe the mechanism of acidic buffer solution with a suitable example.

   b) 60 mL of 0.5 M acetic acid is mixed with 40 mL of 0.25 M sodium hydroxide solution. What will be the $p^H$ of the mixture? (Given Ka = $1.85 \times 10^{-5}$)   [3+2]

3. What are promoters? Describe the adsorption theory of catalysis with a suitable example. Point out criteria of catalysts used for industrial purpose.   [1+3+1]

4. a) What do you mean by chlorofluorocarbons? Mention their photolytic reactions in the upper atmosphere.

   b) Why are the oxides of sulphur and nitrogen assumed as air pollutants?   [3+2]

5. What are the major sources of water pollution? Mention their adverse effects and possible remedies.   [1+2+2]

6. Nylon and Teflon are different polymers. Explain. Give the preparation and uses of epoxy resin.   [3+2]

7. What are chalcogenide glasses? Give an account of preparation and uses of network polymers of sulphur.   [1+4]

8. a) Why are transition elements called so? Are all d-block elements called transition elements? Justify your answer with reason.   [1+2]

   b) Why do transition elements from significant number of complexes?   [2]

9. Explain. Why?

   i) Paramagnetic properties increases from SC to Mn and then decrease to Zn.
   ii) $Zn^{2+}$ salts are white while $Cu^{2+}$ salts are coloured
   iii) $Fe+3$ compounds are more stable than $Fe^{+2}$.   [2.5+1.5+1]

10. $[Co(NH_3)_6]^{3-}$ and $[CoF_6]^{3-}$ are both octahedral but shows marked difference in their magnetic properties. Explain.   [2.5+2.5]

11. Differentiate between double salt and complex salt. Write the application of Werner's theory of co-ordination compound. [3+2]

12. a) Write the characteristics of a good paint and explain the method of application of paint in galvanized iron.

    b) What are lubricating oils? Write the chief functions of lubricants. [3+2]

13. Write the points of difference between high explosives and plastic explosives. Mention the preparation and applications of TNT. [2.5+2.5]

14. All the diastoreomers are stereoisomers but all the stereoisomers are not diastereomers. Explain. Describe the chemical method for resolution of racemic mixture. [3+2]

15. Differentiate between nucleophile and electrophile. Explain the mechanism of dehydrohalogination of 2-Bromo -2- methylpropane. [2+3]

16. Write the reaction mechanism of $SN^2$ reaction with a suitable example. How does it differ from $SN^1$ reaction? [3+2]

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**INSTITUTE OF ENGINEERING**

## Examination Control Division

### 2074 Bhadra

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, BIE, B.Agri., BAM | Pass Marks | 32 |
| Year / Part | I / II | Time | 3 hrs. |

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*Subject*: - Engineering Chemistry *(SH453)*

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✓ 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 are the criteria for buffer system? How many grams of sodium benzoate should be added to 160 mL of 0.13 M benzoic acid solution to obtain a buffer with a pH of 4.3? [pKa value of benzoic acid is 4.2]    [1+4]

2. What is single electrode potential? Can its absolute value be measured? If not, how is the problem solved? Describe with a suitable example.    [1+4]

3. What is meant by catalytic poisoning? Explain intermediate compound formation theory of catalysis referring suitable example.    [2+3]

4. How is global warming caused due to air pollution? Write the consequences of global warming and its possible remedies.    [2+3]

5. What do you mean by point and non point sources of water pollutants? Give an account of primary and secondary processes of waste water treatment to control water pollution.    [2+3]

6. What is biodegradable polymer? Write applications of carbon reinforced polymers and chalcogenide glasses in engineering.    [5]

7. How your acquaintance to polyurethanes and Bakelite.    [2.5+2.5]

8. What are transition elements? Why are all the transition elements not considered as typical transition elements? Explain the electronic configuration of the first transition elements.    [1+1+3]

9. a) Why do transition elements show variable oxidation states? Explain with reference to 3d series elements. .    [1+2]

   b) Explain why compounds of $Ti^{3+}$ are coloured but those of zinc are colourless.    [2]

10. What do you understand by a chelate and a chelating ligand? Describe Sidewick theory of co-ordination compounds with an example. Write down the IUPAC names of the following compounds.    [2+2+1]

    (i) $Na_3[Al(C_2O_4)_3]$    (ii) $[Co(NH_3)_4Cl_2]+$

11. How does valence bond theory explain the formation of $[Fe(CN)6]^{3-}$ . Also explain whether this complex is inner or outer orbital and why?    [3+2]

12. What is plastic explosive? How can you prepare TNT from benzene? Why does detonator require for the explosion of TNT?    [1+2+2]

13. a) What are lubricants? Mention the functions of lubricants.    [2.5]

    b) How is paint applied on wooden articles?    [2.5]

14. a) What is geometrical isomerism? Why is trans-isomer more stable than Cis-isomer? Why is geometrical isomerism not possible in propene? [3]

b) Find out E or Z configuration in the following molecules. [2]

(i)

$$Br\diagdown\underset{I\diagup}{C}=C\underset{\diagdown Cl}{\diagup F}$$

(ii)

$$CH_3\diagdown\underset{H\diagup}{C}=C\underset{\diagdown F}{\diagup C_2H_5}$$

(iii)

$$I\diagdown\underset{Br\diagup}{C}=C\underset{\diagdown CH_3}{\diagup C_6H_5}$$

(iv)

$$C_2H_5\diagdown\underset{CH_3\diagup}{C}=C\underset{\diagdown OH}{\diagup I}$$
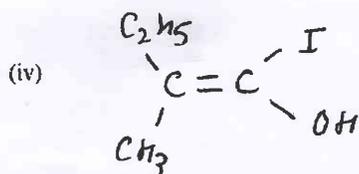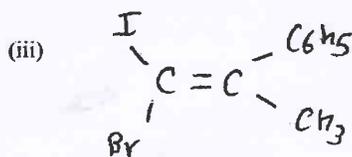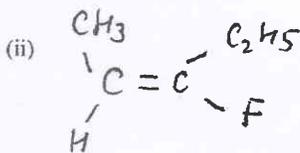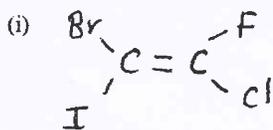
15. What is meant by SN reaction? Explain the mechanism for the nucleophillic reaction that proceeds with and inversion of configuration. Why inversion product predominates more than retention product is $SN_1$ reaction. [1+3+1]

16. What do you mean by elimination reaction? Write the mechanism for dehydrohalogenation in primary alkylhalide. Show your acquaintance to Saytzeff's rule. [1+2+2]

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| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, BIE, B.Agri., BAME | Pass Marks | 32 |
| Year / Part | I / II | Time | 3 hrs. |

## *Subject:* - Engineering Chemistry *(SH453)*

✓ 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 non-standard electrode potential? Calculate the emf of the cell obtained from given electrode reactions.

$$Fe^{++} (0.2M) + 2e^- \rightarrow Fe \qquad E^0 = (-0.44 \text{ V})$$
$$Ag \rightarrow Ag^+ (0.1M) + 2e^- \quad E^0 = (-0.80 \text{ V}) \qquad [1+4]$$
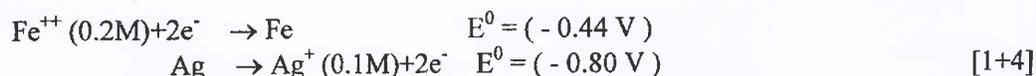
2. Define Buffer. Derive Henderson's equation for acidic buffer. Calculate the pH of the solution formed by adding 0.4 g of NaOH on 500 mL 0.2 M acetic acid. pKa for acetic acid = 4.74. [1+2+2]

3. What is autocatalysis? Distinguish between positive and negative catalysis with examples. How does poison paralyze the activity of a catalyst? [1+3+1]

4. a) What are Freons? Describe their role in the depletion of ozone layer with the photochemical reactions.

   b) How does carbon dioxide cause atmospheric pollution? [1+2+2]

5. What is air pollution? What are the main pollutants of air and their sources? Give possible remedies of air pollution. [1+2+2]

6. What are biodegradable polymers? Write down the preparation and uses of Nylon and Teflon. [1+4]

7. What is inorganic polymer? Give an account of preparation and application of network polymer of Sulphur in engineering field. Also mention the two uses of silicones. [1+3+1]

8. a) What are solid lubricants? Under what condition, they are used.

   b) Mention the requisites of good paint. Explain the method of application of paint in galvanized iron. [2+3]

9. a) Why do transition elements form complexes? [2]

   b) Why are most of the compounds of transition elements are coloured? [3]

10. a) Why do the transition metals show paramagnetism? [2.5]

    b) Why do transition metals exhibit variable oxidation states? [2.5]

11. What are principle and auxiliary valencies of the metal in the complex compounds? Illustrate with suitable example. Write the IUPAC names of

    a) $Na[Ag(CN)_2]$
    b) $[Co (NH_3)_4 H_2O.Cl] Cl_2$
    c) $[Cr (en)_3] Cl_3$
    d) $K_4 [Mn (Cl)_6]$ [3+2]

12. Explain the formation of $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ on the basis of Valence Bond Theory and also predict their magnetic property. [2+2+1]

13. What are high explosives and low explosives? Write the preparation and uses of TNT. [2+3]

14. a) Define enantiomers and diastereomers. [2]

  b) Write all the possible stereoisomers of tartaric acid. Does tartaric acid has meso form? Explain with reason. [2+1]

15. Describe the mechanism for the conversion of Bromomethane into methanol in presence of aq. alkali. Why does $SN^2$ reaction take place with stereochemical inversion? [3+2]

16. What is elimination reaction? Explain the reaction mechanism for the dehydrohalogenation of tertiary alkyl halide. [1+4]

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| Exam. | | Regular | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, BIE, B.Agri., BAME | Pass Marks | 32 |
| Year / Part | I / II | Time | 3 hrs. |

## Subject: - Engineering Chemistry (SH453)

✓ 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 electrode potential. How do you measure standard electrode potential of zinc electrode? Find the Emf of the following cell at 25°C.    [1+2+2]
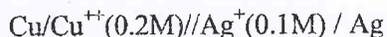
   $Cu/Cu^{++}(0.2M)//Ag^{+}(0.1M) / Ag$
   Given: $E°Ag^{+}/Ag = 0.80V$ and $E°Cu/Cu^{++} = -0.34 V$

2. What are the criteria for buffer system? Calculate the weight in gram of $NH_4Cl$ required to prepare buffer solution with 2 litre of 0.2N $NH_4OH$ solution with pH = 9. $(K_b = 1.8 \times 10^{-5})$    [2+3]

3. How does a catalyst increase the speed of a reaction? Explain heterogeneous catalysis. Explain with an example the adsorption theory of catalysis.    [1+1+3]

4. What are water pollutants? Write the major sources of water pollution. How do the oxides of sulphur and nitrogen make water acidic?    [1+2+2]

5. Write notes on:    [2.5+2.5]

   a) Acid rain
   b) Ozone depletion

6. What is paint? What are the requisites of good paint? Show your familiarity with the types of paints.    [1+2+2]

7. a) Write the preparation and uses of polyphosphonitrilic chloride.    [2.5]

   b) Write the types of silicones and their uses.    [2.5]

8. Write short notes on Bakelite and Teflon.    [2.5+2.5]

9. Write the important characteristics of explosives? Give the preparation and uses of TNT? Why does detonator required for the explosion of TNT?    [2+2+1]

10. What are transition elements? Write the electronic configurations of the 1st row transition series. The paramagnetism of substance is due to the presence of unpaired electrons. Explain.    [1+2+2]

11. Give the reasons for the features of the transition metals.

    a) Most of the transition metal ions are colored in solution.
    b) Transition metals are well known to form complex compounds.    [2.5+2.5]

12. a) Differentiate between complex compounds and double salts.    [1]

    b) Write the IUPAC name of the following complexes compounds and find the Effective Atomic Number of the central metal in these complexes.    [4]

       (i) $[Co(NH_3)_6]Cl_3$
       (ii) $[Cr(H_2O)_4Cl_2]Cl$
       (iii) $[Cu(NH_3)_4]SO_4$
       (iv) $K_3[AlF_6]$

13. Using VBT, explain as to show the two complexes $[Ni(CN)_4]^{2-}$ and $[Ni(Co)_4]$ have different structure but do not differ in their magnetic behavior. [5]

14. a) Write Cis, Trans and Z, E notation for the possible isomer of but-2-enedioic acid.

   b) Distinguish between enantiomers and disterioisomers. Give an example to support your answer. [2+3]

15. Write the mechanism of the reaction of tertiary alkyl halide with

   a) Aqueous NaoH
   b) Alcoholic KOH [2.5+2.5]

16. a) How does the reaction of bromomethane occur with aqueous caustic soda?

   b) Explain the reaction mechanism of dehydrohalogenation of 1° alkyl halide. [2.5+2.5]

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| Exam. | Regular / Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, BIE, B.Agri. | Pass Marks | 32 |
| Year / Part | I / II | Time | 3 hrs. |

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### Subject: - Engineering Chemistry *(SH453)*

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✓ 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 capacity and buffer range. Calculate the concentration of sodium benzoate that must be present in 0.1 M benzoic acid to make a buffer solution of pH 3.7 ($K_a$ for benzoic acid is $1.8 \times 10^{-4}$)  [2+3]

2. What is electrode potential? How does it originate? What will be the reduction potential of $Zn^{2+}/Zn$ electrode when zinc metal in contact with 0.1 M $H_2SO_4$ at 25°C. Given $E^0_{Zn/Zn2+} = +0.768V$.  [1+1+3]

3. Define heterogenous catalysis. Describe the absorption theory of catalysis with suitable example. Write any two criteria of choosing catalyst for industrial purpose.  [1+3+1]

4. Global warming is one of the burning issues of the world. Point out major causes of global warming, its impacts and also control measures.  [1+2+2]

5. What do you mean by water pollution? What are the major water pollutants, mention their adverse effects.  [1+2+2]

6. Explain preparation and uses of polyphosphazines and polymeric sulfur nitride.  [2.5+2.5]

7. What is biodegradable polymer? Mention preparation and uses of the following.  [1+2+2]

   a) Epoxy resin             b) Polyurethane

8. Give reasons for  [2.5+2.5]

   a) Cu(I) is diamagnetic where as Cu(II) is paramagnetic.
   b) $TiO_2$ is white but $TiCl_3$ is violet.

9. Give reasons:  [2.5×2]

   a) The components formed by symbol 'V' element in +5 oxidation state are colourless but those formed in +3 oxidation state are colourful.
   b) Transition elements are mostly paramagnetic.

10. What do you mean by effective atomic number? Give IUPAC name and calculate the effective atomic number of the following complexes.  [1+4]

    a) $[Fe(CN)_6]^{3-}$
    b) $[Ag(NH_3)_4]^+$
    c) $[Ni(CN)_4]^{2-}$
    d) $[Cr(H_2O)_6]^{2+}$

11. What are the inner orbital and outer orbital complexes? Explain formation of $[Fe(CN)_6]^{4-}$ on the basis of valance bond theory and predict its magnetic behavior.  [2+3]

12. Explain why $SN^1$ reaction gives both retension and invertion isomers but $SN^2$ gives only invertion isomer. Write the mechanism of given chemical reaction. [2+3]
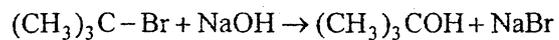
$$(CH_3)_3C - Br + NaOH \rightarrow (CH_3)_3COH + NaBr$$
$$(aa)$$

13. Distinguish between enantiomers and diasteriomers. Show these isomers in 3-bromo-2-butanol. [2+3]

14. What is an explosive? Classify explosives with examples. What is the requirement of good explosives? [1+2+2]

15. What are elimination reactions? Write the differences between $E_1$ and $E_2$ reaction mechanism taking suitable example. [1+4]

16. a) What is lubricant? Write about the application of different types of lubricants. [1+2]

    b) Write the characteristics of good paint. [2]

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| Exam. | Regular (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT,BIE, B.Agri | Pass Marks | 32 |
| Year / Part | I / II | Time | 3 hrs. |

## Subject: - Engineering Chemistry *(SH453)*

✓ 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 of Zn-Cu cell.  [2+1+2]

2. What is meant by buffer solution? Calculate the concentration of sodium formate, HCOONa, that must be present in a 0.10M solution of formic acid to produce a pH of 3.80. [$K_a$ for formic acid is $1.8 \times 10^{-4}$].  [1+4]

3. Explain the terms: (a) Homogeneous catalysis (b) Catalytic poisoning (c) Promoters. [2+1.5+1.5]

4. What are major gases responsible for causing green house effect and how are they released into the atmosphere? Give an account of the globel efforts to control the release of these gases.  [1+2+2]

5. What are the main sources of water pollution? Write the effect of water pollution on mankind. Mention the measures to control water pollution.  [1+2+2]

6. Write short notes on: (a) Sulphur based polymers (b) Polyphosphazines.  [3+2]

7. a) What are monomers of: (i) Polyurethane (ii) Nylon 6,6 (iii) Bakelite (iv) Epoxy resin.  [2]

   b) What are the engineering application of : (i) Polyvinyl chloride (ii) Conducting polymer.

8. Why do transition metals: (i) Form complex compound (ii) Exhibit variable oxidation states.  [1+2+2]

9. Why are 3d-series elements called transition elements? Give their characteristic on the basis of valency.  [2+3]

10. Differentiate between low spin and high spin complexes. Explain the geometry and magnetic behaviour of $[Ni(CO)_4]^\circ$ on the basis of valence bond theory.  [2+3]

11. a) Differentiate between complex salts and double salts. Calculte EAN of the central metal atom in $Fe(CN)_6$  [2.5×2]

    b) Write the IUPAC name of the following co-ordination compounds.
       (i) $K[PtCL_5(NH_3)]$ (ii) $[CO(NH_3)_5SO_4]Br$

12. a) Mention the importance of primary and low explosives. Give the preparation and uses of TNT and TNG.  [5]

13. a) What are lubricating greases? Give their functions.  [1+2+2]

    b) Show your acquaintance with types of paints.

14. What is optical activity? Give the sterioisomers of tartaric acid. Would you expect the following compound to be optically active? Explain. [1+3+1]

$$\text{HOOC} - \underset{\underset{Br}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{Br}{|}}{\overset{\overset{H}{|}}{C}} - \text{COOH}$$
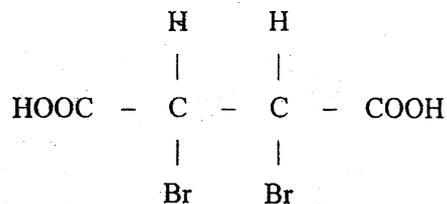
15. How do SN1 and SN2 reactions differ in haloalkane? Mention the factors which regulates the reaction. [3+2]

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 | BEL, BEX, BCT, BME, BIE | Pass Marks | 32 |
| Year / Part | I / II | Time | 3 hrs. |

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## 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 a galvanic cell differ from an electrolytic cell? Calculate the emf of the following cell at 25°C giving electrode reactions and cell reaction.          [1+4]

    $Cd(s)cd^{++}(0.01M)//Cu^{++}(0.5M)Cu(s)$
    $E^0Cd^{++}/cd = -0.140V, E^0Cu^{++}/cu = 0.34V$

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 with suitable examples.          [1+1+3]

4. Brief discuss sources of organic and inorganic substances responsible for water pollution. Point out their adverse effects possible remedies.          [3+2]

5. a) What is meant by global warming? Give its causes and consequences.          [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 bakelite and polyurethanes.          [4]

    b) What are the advantages of conducting polymers?          [1]

8. a) What are transition elements? List the industrial application 3d transition elements.          [1+2]

    b) Why do transition elements show variable oxidation states?          [2]

9. Explain the following features of transition elements with reference to 3d transition series:          [3+2]

    a) Formation of complex compounds

    b) Formation of colored compounds

10. Differentiate between complex salts and double salt. How does Werner's theory explain the bonding in complex salts?          [1+4]

11. Write the formulae of following:          [2]

    i) Potassium hexacyanoferrate (III)
    ii) Trioxalatoaluminate (III) ion
    iii) Trist ( ethylenediamine) chromium (III) chloride
    iv) Bis (benzene) chromium(0)

b) How does valence bond theory explain the formation of $[Ni(NH_3)_6]^{2+}$? Predict its magnetic behaviour. [3]

12. What are low explosives? Write their uses. Give the preparation and applications glycerol trinitrate. [2+3]

13. a) What are lubricating oils? Indicate their importance in engineering. [2]

b) What are paints? Discuss any two types of paints indicating their applications in engineering works. [3]

14. a) What are geometrical isomers? Give an example specifying Z and E configuration. [2]

b) Show your familiarity with enantiomerism diastereomerism. [3]

15. Discuss the unimolecular nucleophilic substitution reaction mechanism in alkylhalide showing the stereochemistry. What type of solvent favors this type of mechanism? [4+1]

16. What is meant by elimination reaction? Discuss $E^1$ and $E^2$ reaction mechanisms. [1+4]

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| Exam. | | Regular / Back | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, BIE, B.Agri. | Pass Marks | 32 |
| Year / Part | I / II | 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. What is meant by standard electrode potential? Give the electrode reactions and calculate the emf of the following cell at 25°C. [1+4]

   $Fe^{++} = Fe^{+++} + e^-$, $E° = -0.77V$
   $Ni^{++} + 2e^- = Ni$, $E° = -0.25V$
   $[Ni^{++}] = 0.2M$, $[Fe^{++}] = 0.1M$, $[Fe^{+++}] = 1M$.

2. What is a buffer? 1.64 g of anhydrous sodium acetate is added to 200ml of 0.2M acetic acid. What is the pH of buffer? Calculate the degree of ionization of the acid in the solution.(Ka of acid = $1.8 \times 10^{-5}$) [1+4]

3. Describe the adsorption theory of catalysis with an example. How does a poison paralyze the activity of a catalyst? Give any two industrial applications of catalysts. [3+1+1]

4. Write short notes on: [3+2]

   a) Global warming
   b) Acid rain

5. What is meant by soil pollution? Point out the major sources of soil pollution, their adverse effect and their possible remedies. [1+2+1+1]

6. a) What are polyphosphonitrilic compounds? Give one method for the preparation of polyphosphonitrilic compound and mention the uses. [3]

   b) What are silicones? Give any two uses of silicones. [2]

7. a) What is a thermosetting polymer? Write down the uses of epoxy resin. [2]

   b) What are conducting and biodegradable polymers? Point out the applications of conducting polymers in engineering. [3]

8. What are transition elements? Explain the variable oxidation states exhibited by 3d series. Why does the transition elements form alloy? [1+3+1]

9. Explain the followings: [3+2]

   a) Transition elements are good in forming complexes.

   b) $TiO_2$ is white but $TiCl_3$ is violet

10. What is complex salt? Give the main postulates of Werner's coordination theory. [1+4]

11. a) Explain the formation of $[Fe(CN)_6]^{4-}$ on the basis of valance bond approach and predict its magnetic behavior. [3]

b) Write the IUPAC name of the followings; [2]

    i) $K_3[Fe(CN)_6]$

    ii) $Na_3[Al\ C_2O_4)_3]$

    iii) $[Co\ Cl.CN.NO_2.(NH_3)_3]$

    iv) $[Cr\ (NO_3)_6]^{3-}$

12. What are characteristics of an explosive? Give the preparation of glycerol trinitrate (GTN) and trinitrotoluene (TNT). Point out the industrial applications of explosives.

[1+1.5+1.5+1]

13. a) What is paint? Give the requisites of a good paint. - [1+2]

b) What are lubricating greases? Give their functions. [1+1]

14. a) Define enantiomers, racemic mixture and meso compound giving one example of each. Also comment on their optical activity. [4]

b) Draw the structure and specify Z and E configuration of 1- Bromo-1 chloropropene. [1]

15. Explain the $S_N2$ reaction mechanism with reference to hydrolysis of alkylhalide. What type of solvent favors this type of path? How can you say that carbocation is not formed during $S_N2$ reaction? [3+1+1]

16. Write the mechanism of unimolecular elimination reaction. How does it differ from bimolecular elimination reaction? [3+2]

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| Exam. | New Back (2066 Batch Only) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, BIE, B.Agri. | Pass Marks | 32 |
| Year / Part | I / II | 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. What is normal hydrogen electrode? A galvanic cell consists of a metallic nickel plate immersed in 0.1M $Ni(NO_3)_2$ solution and a metallic plate of copper in 0.2M $CuSO_4$ solution. Calculate the emf of this cell. [2+3]

   $E^\circ {}_{Ni^{++}/Ni} = -0.25V$          $E^\circ {}_{Cu^{++}/Cu} = +0.34V$

2. What is corrosion? Calculate the pH of a resulted solution when 0.1 gm of NaOH is added to 200ml of 0.1M acetic acid solution. ($pK_a = 4.74$). [1+4]

3. What is catalyst? Explain positive and negative catalysis with two examples for each. [1+2+2]

4. Define heterogeneous catalysis. Give a brief account on theory of Heterogeneous catalysis. [1+4]

5. Give an account of acid rain? What are the sources of CO and $SO_2$ pollutants in air? How are they controlled? [1+2+2]

6. What is ozone depletion? Explain its causes. Mention the major pollutants of water? [1+2+2]

7. Differentiate thermosetting and thermoplastics polymers. Write the name and the preparation of the organic polymers that are used for (i) Preparing ropes and socks (ii) Preparing non stick cooking utensils. [2+3]

8. What is linear chain polymer? Write the preparation and uses of different types of sulphur bases inorganic polymers. [1+4]

9. What are d-block elements? Give the electronic configuration of 3d series. Mention which d block metals are not considered as transition as transition metals and why? [1+2+2]

10. Explain the following: [2+3]

    a) Transition metals exhibit variable valency.
    b) Transition elements are very good in forming complexes.

11. How does the valence bond theory account for the following facts? [5]

    a) $[Fe(CN)_6]^{-4}$ ion is diamagnetic but $[Fe(CN)_6]^{-3}$ is paramagnetic
    b) $[Ni(CO)_4]^0$ is diamagnetic and tetrahedral.

12. Identify the complex ion and legends in the compound $[Co(NH_3)_6]Cl_3$. Write the formulae of the following co-ordination compounds. [2+3]

   a) Dichloro tetra-aquo chromium (III) cation
   b) Tris (ethylene diamine) chromium(III) chloride
   c) Dicyano argentate (I) ion
   d) Bromo penta-ammine cobalt (III) sulfate
   e) Sod. hexa nitrito cobaltate(III)
   f) Hexa-cyanoferrate (III) ion

13. Define Dynamite and plastic explosive. Write the preparation, properties and uses of Nitro cellulose. [2+3]

14. What are greases? Mention their specific uses. Write short note on varnish. [2+1+2]

15. What is optical isomerism? Comment why presence of chiral centre is not sufficient for the molecule to be optically active. [1+4]

16. Explain the reaction mechanism involved when primary alkyl halide react with alcoholic alkali and aqueous alkali. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2066 Magh**

| Exam. | | Regular/Back | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, BME, BIE | Pass Marks | 32 |
| Year / Part | I / II | 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) Derive Schrodinger wave equation for the wave mechanical model of an atom and write the significance of $\psi$ and $\psi^2$. [5]

   b) State Heisenberg uncertainty principle. How this principle goes against Bohr's theory? Explain. [1+3]

2. a) What is de Broglie's equation? Derive a relation between wave length ($\lambda$) associated with particle of mass m moving with a velocity V. [1+2]

   b) Calculate the de Broglie wavelength for a ball of 200 gm mass moving with a velocity of $3 \times 10^{10}$ cm/sec and an electron moving with the same velocity. What these values indicate? [4]

3. a) What is buffer action? Explain clearly why a solution of weak acid and its salt with a strong base behaves as a buffer solution. [1+3]

   b) 100 m$\ell$ of 1M $H_2SO_4$ and 50 m$\ell$ of 2M NaOH are mixed together. Calculate the pH of the resulting solution. [4]

4. a) What is electrochemical series? Write its applications. [4]

   b) Calculate the emf of the cell: Ni/Ni$^{++}$(1M) // Pb$^{++}$ (1M) / Pb at 25°C [4]

   Write down its cell reaction. Standard electrode potential of Ni and Pb are −0.24V and −0.13V respectively at 25°C.

### Group B

5. a) Explain why transition metals (i) show variable oxidation states and (ii) form large number of complexes. [6]

   b) Write down the uses of silicones. [2]

6. a) Write down the conditions necessary for hybridization. Discuss the types of hybridization in $SF_6$ molecule. [2+4]

   b) Explain the formation of $N_2$ molecule on the basis of VBT. [2]

7. a) $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$, both are octahedral complexes. What is the difference between the two? Explain on the basis of VBT. [3+3]

   b) Write down the IUPAC names of the following co-ordination compounds (i) $K_3[Co(CN)_5C\ell]$ (ii) $[Pt\,C\ell\,(NO_2)(NH_3)_2]$ (iii) $[Pt\,(OH)_4]^{2-}$ (iv) $K_2[HgI_4]$. [2]

   **OR**

   a) Write down the main postulates of Werner's co-ordination theory. [5]

   b) The formation of inner orbital complexes of Ni$^{+2}$ (CN=6) is not possible. Explain with example. [3]

### Group C

8. a) Explain the reaction mechanism of unimolecular elimination reaction with a suitable example. [4]

   b) What does $SN^2$ and $E_2$ represents? Write one example of each. [2+2]

   **OR**

   a) Explain the reaction mechanism of bimolecular nucleophilic substitution reaction with a suitable example. [4]

   b) Write $E_1$ and pinacol pinacolone rearrangement reactions. [2+2]

9. a) Define geometrical and optical isomerisms with suitable examples and write the differences between enantiomers and diastereomers. [3+3]

   b) What happens when toluene is treated with chlorine in different conditions? [2]

10. a) Describe the preparation and uses of Teflon and Nylon 6,6. [3]

    b) What are explosives? Describe the preparation and uses of nitroglycerol. [3]

    c) How can you obtain carboxylic acid and ethanol from Grignard's reagent? [2]
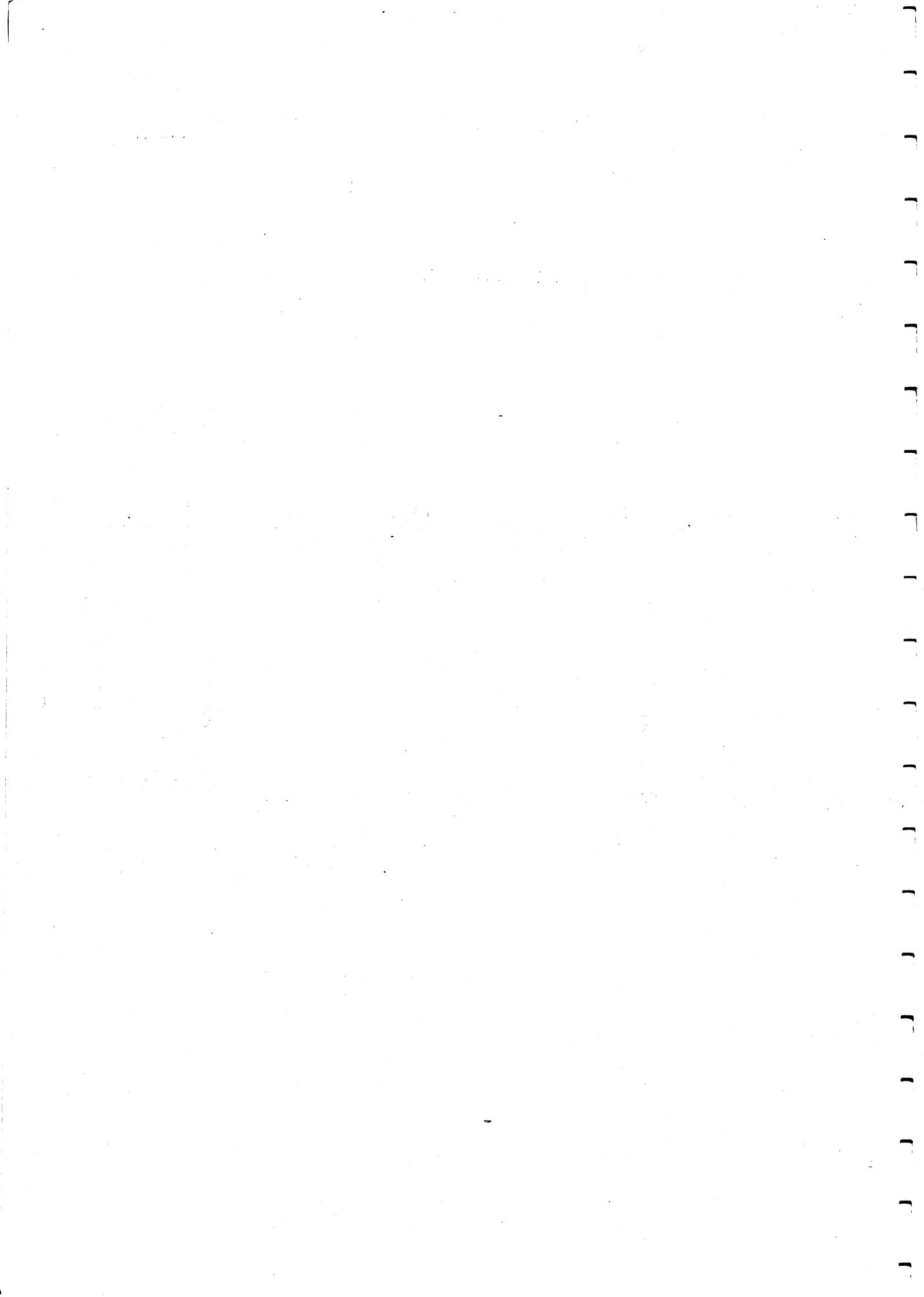
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| Exam. | | Back | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, BME, BIE | Pass Marks | 32 |
| Year / Part | I/ II | Time | 3 hrs. |

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## Subject: - Chemistry

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Five** questions selecting at least **Two** from **Group A**, **One** from **Group B** and **One** from **Group C**.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

### Group A

1. a) What is meant by 'buffer solution' and 'buffer action'? Explain clearly, why a solution of weak acid and its salt with a strong base behaves as a buffer solution.

   b) Explain Sommerfeld's extension of Bohr's atomic model. Calculate the uncertainty in the position of an electron moving with velocity 600 m/s if error in the measurement of velocity is 0.005%. Comment on the result.    [8+4+4]

2. a) What is electrochemical corrosion? Explain the mechanism of corrosion and methods of its prevention.

   b) 1.64 gm of anhydrous sodium acetate is added to 400 ml of 0.2M acetic acid. What is the pH of buffer? Also calculate the degree of ionization of the acid in the solution.    [8+8]

3. a) What do you understand by the terms $c_p$ and $c_v$? How are they related with each other? Derive the relationship.

   b) What is normal hydrogen electrode? Calculate the emf of the following cell at 25°C.    [8+2+6]

   $Zn/Zn^{++}$ (0.1M) // $Ag^+$ (1.2M)/Ag

   $E° Zn/Zn^{++} = +0.76V$

   $E° Ag/Ag^+ = -0.80V$

4. a) What is Aufbau principle? State and explain (n + l) rule. Write down the configurations of Cu and Cr. Why don't these elements follow Aufbau principle?

   b) Define the terms internal energy change and enthalpy change. How are they related? Calculate the work done when one mole of a gas at 25°C and 5 atm. pressure is allowed to expand isothermally but irreversibly against a constant external pressure of 1 atm. until the internal pressure is reduced to 1 atm.    [8+4+4]

### Group B

5. a) What are the conditions for hybridization? Discuss the type of hybridization that exists in the octahedral shape of molecule with an example.

   b) Describe the formation of outer and inner orbital complexes on the basis of valence bond theory.    [4+4+8]

6. a) Why one d-block elements known as transition elements? Explain, why transition metals (i) form coloured compounds (ii) show variable oxidation state.

   b) What are cyclic silicones? How are they formed?

7. Explain following giving appropriate reasons. [4×4]

   a) Aqueous solution of $[CO(NH_3)_5Cl]Cl_2$ gives white ppt with $AgNO_3$ solution but $[CO(NH_3)_3Cl_3]$ does not.

   b) $CH_4$ and $H_2O$ molecules have tetrahedral geometry but their bond angles are different.

   c) $PCl_5$ exists in nature but $NCl_5$ does not.

   d) σ bond is stronger than π bond.

## Group C

8. Explain the mechanism involved in the following reactions (a) hydrolysis of methyl bromide by aqueous sodium hydroxide. (b) Dehydrohalogination of tertiary butyl bromide by alcoholic sodium hydroxide. Give reasons. Why (i) Tertiary butyl bromide undergoes $SN^1$ reaction but methyl bromide undergoes $SN^2$ reaction. (ii) $SN^1$ reaction gives both retention and inversion products but $SN^2$ reaction gives inversion product only.
[4+4+4+4]

9. a) Describe the following with examples.

   (i) Enautiomers (ii) Diastereomers (iii) Racemic mixture (iv) Meso compound. Justify the statement "All the diastereoisomers are stereoisomers but all the stereoisomers are not diastereoisomers".

   b) What happens when (i) Glycerol undergoes nitration (ii) Chlorine is passed boiling tolueue in presence of uv light. [8+4+4]

10. Write short notes on: [8+8]

   a) Addition polymerization giving preparation of (i) Teflon (ii) Polyster.

   b) Starting from Grignard's reagent, how would you obtain (i) 1° alcohol (ii) 2° alcohol (iii) 3° alcohol (iv) higher alkane. [8+8]

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| Exam. | Regular/Back | | |
|--------|------|------|------|
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## Subject: - Chemistry

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt _All_ questions.
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✓ Assume suitable data if necessary.

### Group A

1. a) Write down the limitation of Bohr's atomic theory. [4]

   b) What is energy rule? Calculate of wave length of matter wave of electron. [2+2]

2. a) What is pH scale? Write down the limitation of pH meter. [2+1]

   b) Calculate teh pH change of buffer solution 100 C.C of semimolar $NH_4OH$ and 400 C.C of N/10 $NH_4Cl$ in which 20 ml of 0.5 N HCl is added ($K_b = 1.8 \times 10^{-5}$) [5]

3. Give the electro chemical mechanism of corrosion. Calculate the molarity of $Fe^{++}$ ion in the cell when iron electrode is combined with standard AgCl/Ag, $Cl^-$ electrode having emf 0.57V of cell. [4+4]

   Given,     $E^o_{AgCl}, Cl^- = +0.22V$

   $E^o_{Fe/Fe^{++}} = +0.44V$

4. Derive Kirchhoff's equation. Calculate the heat of formation of $CH_4$ gas if enthalpy of cobustion of $CH_4$ gas is –890 KJ, the amount of heat evolved by burning of coke is 394 KJ and standard enthalpy of formation of water is –286 KJ. [4+4]

### OR

Write short notes on: [4+4]

   a) Enthalpy
   b) Calorific value of food

### Group B

5. a) What are co-ordination compounds? Write down the main postulates of Werner's theory. [1+4]

   b) How does the valence bond theory explain the formation of tetrahedral complexes? [3]

### OR

   a) What are the differences between inner orbital and outer orbital complexes? Explain on the basis of valence bond theory the structure of $[FeF_6]^{3-}$. [2+4]

   b) Write down the IUPAC names of the following compounds. [2]

   i) $[Co(NH_3)_4SO_4]NO_3$
   ii) $Na_3[Co(NO_2)_6]$
   iii) $Na_3[Al(C_2O_4)_3]$
   iv) $[Pb(OH)_4]^{2+}$

6. a) What are transition elements? What do these elements [1+2+2]

    i) form large number of complexes

    ii) form coloured compounds

  b) Give the four important properties and uses of silicons. [2]

7. a) What are the postulates of valence bond theory of covalent bond? [3]

  b) What is hybridization? How does the shape of octahedral molecules better explained on the basis of hybridization. [1+4]

## Group C

8. a) Give an account of stereoisomerism shown by but – 2 – ene – 1, 4 – dioic acid and 2 – hydroxypropanic acid. [3]

  b) Differentiate between racemic mixture and meso compound. [2]

  c) Write the possible isomers of 2, 3 – dichloropentane and mention enantiomers and diastereomers. [3]

9. a) Explain the SN reaction mechanism. Which occurs both by retention and inversion of configuration. [4]

  b) Describe the mechanism involved in the reaction between tertiary butyl bromide and alcoholic KOH. [4]

### OR

  a) Why do $SN_1$ mechanism occur in two steps?. [2]

  b) Why does the attack of nucleophile on tertiary butyl carbonium ion mostly prefer from back side? [2]

  c) Give an account of Pinacol – pinacolone rearrangement and dehydro halogenation of 3 – alkyl halide. [4]

10. a) Write the preparation and uses of polymers formed by the polymerization of tetrafluoroe thylene and vinyl chloride. [4]

  b) What happens when [4]

    i) Grignard reagent reacts with ethanol

    ii) Methyl benzne is oxidised by acidic chromyl chloride

    iii) Toluene is treated with fuming nitric acid

    iv) n-heptane undergoes aromatisation

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