WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 6th Semester Examination, 2022

CEMACOR13T-CHEMISTRY (CC13)

INORGANIC CHEMISTRY-V

Time Allotted: 2 Hours   Full Marks: 40

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

**Answer any *three* questions taking *one* from each unit**

Unit-I

1. (a) Name one zinc containing metallo-enzyme and explain its biological function. 1+3

   (b) What is biological nitrogen fixation? Explain. 3

   (c) What are the biological functions of the following? 3

       (i) Myoglobin and

       (ii) Ferridoxin.

   (d) Indicate the oxidation state of copper ions in deoxy- and oxy-hemocyanin. What is the oxidation state of O_2 ligand in oxyhemocyanin? 1+1+1

   (e) How can you differentiate oxygen carrier and oxygen transport proteins? Explain with examples. 3

2. (a) What difference is noted in the binding of oxygen to hemoglobin and hemerythrin? 4

   (b) Discuss the role of PS-I and PS-II in photosynthesis. Name an electron transport protein involved in the process. 4+1

   (c) Name two toxic elements and describe their toxic effects. 4

   (d) What is *cis*-Platin? State its medicinal use. Why is *trans*-isomer not active as a medicine? 3

Unit-II

3. (a) What do you mean by hapticity? Cite examples of mono-, tri- and penta hapto cyclopentadienyl complexes. 1+3

   (b) Giving examples explain the different coordination modes of NO. 3

   (c) Discuss the mechanistic steps in Wacker process of oxidation of olefins. 3

(d) Identify A and B with explanation: 3

$$Fe(CO)_5 \xrightarrow[\text{(ii) Metallic Na Reflux}]{\text{(i) Dry THF}} A \xrightarrow{CH_3Br} B$$
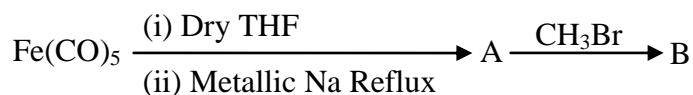
(e) Define with example, oxidative addition reaction. What type of compounds generally undergo this type of reaction? 1+2

4. (a) Illustrate with example that isocyanide stabilize higher oxidation state. 2

(b) Using 18-electron rule, establish the structure of $Os_3(CO)_{12}$ and $Co_4(CO)_{12}$. 4

(c) Write a method of preparation of ferrocene and give the product of the reaction: 4

$$Ferrocene + (CH_3CO)_2O/H_3PO_4 \rightarrow.$$

(d) What is meant by 'hydroformylation' reaction? 2

(e) Name and describe the catalyst in homogenous hydrogenation of alkene. How is it different from Zieglar-Natta catalyst? 4

Unit-III

5. (a) State two factors affecting rate of substitution reaction. 2

(b) Elucidate the mechanism of the following substitution reaction: 2+2

$$[Co(NH_3)_4(Cl_2)]^+ + H_2O \rightarrow [Co(NH_3)_4(H_2O)Cl]^{2+} + Cl^-$$
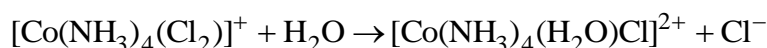
Explain the effect of charge on the complex.

(c) Differentiate between labile and inert complex. 2

6. (a) Write down the products (with reaction steps) when the *cis*- and *trans*-isomers of $[Pt(NH_3)_2Cl_2]$ react with excess thiourea (tu). Explain the reaction with the help of *trans*-effect. 4

(b) Explain the *trans*-effect phenomenon by polarization theory with example. 2

(c) Explain the term CFAE and its importance. 2

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 6th Semester Examination, 2022

CEMACOR14T-CHEMISTRY (CC14)

PHYSICAL CHEMISTRY-IV

Time Allotted: 2 Hours   Full Marks: 40

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Answer any *three* questions taking *one* from each unit

UNIT-I

1. (a) Terms having their usual meanings, show that for a diatomic molecule the quantum number (J_{max}) of the rotational energy level with maximum population of molecules is given by the expression. | 3

$$J_{max} = \sqrt{(k T/2 B h c)} - \frac{1}{2}$$

   (b) Given that the spacing of lines in the microwave spectrum of $^{35}Cl\,^{19}F$ is constant at $1.033\ cm^{-1}$, calculate the moment of inertia and bond length of the molecule $(m(^{35}Cl) = 34.9688\ u, m(^{19}F) = 18.9984\ u)$. | 3

   (c) What do you mean by Rayleigh, Stokes and anti-Stokes lines in a Raman spectrum? How do the characteristics of a Raman spectrum depend on (i) the nature of substance and (ii) the wave length of the radiation? | 4

   (d) Vibrational wave number of HCl, DCl, D_2 and HD at their $v = 0$ vibrational states are 2885, 1990, 2990 and $3627\ cm^{-1}$ respectively. Calculate the energy change (in $kJ\,mol^{-1}$) associated with the following reaction and indicate whether the reaction is exothermic or endothermic. | 4

$$HCl + D_2 = DCI + HD$$
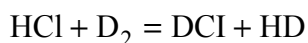
2. (a) In a roto-vibrational spectra, a Q-band is usually absent, Why? What is the line spacing between the 1st P and R line of the roto-vibrational spectra? What will be the relative intensities of these two lines for $^{1}H^{19}F$ at 20ºC with bond distance $2.9 \times 10^{-9} m$? | 1+1+4

   (b) What is the nomenclature of the Raman lines obtained at higher wavelength than the incident frequency? The intensity of such lines are more than that of the lower wavelength lines. Justify / criticize the statement. In rotational Raman spectra the line spacing between the 1st lines of the O and S bands is given as 154Å. What is the value of the rotational constant (B)? | 1+2+2

(c) Write the expression for the nuclear magneton and hence derive its SI unit. Calculate the magnetic field needed to satisfy the resonance condition for unshielded proton in a 150MHz radiofrequency field. 3

UNIT-II

3. (a) State and explain Stark-Einstein law of photochemical equivalence. Is this law always valid for very high intensity LASER radiation? Give reasons for your answer. 4

(b) Why are low temperature and viscous medium suitable for high intensity phosphorescence? 2

(c) Rate of formation of CO due to photodecomposition of propionaldehyde with radiation of wavelength 3025 Å is 2.05×10^{-9} mol. s^{-1}. If the intensity of the incident radiation is 1500 erg s^{-1}, find the quantum yield. 3

(d) What do you mean by 'photosensitized reactions'? Give example of one such reaction that is useful to living system. $1\frac{1}{2}+1\frac{1}{2}$ $=3$

4. (a) A dye solution (0.01 g/cc) absorbs 40% of blue light in a cell of thickness 1 cm. What would be the concentration to ensure 90% absorption in the same cell? 3

(b) Plot I_a (Intensity of absorbed light) vs. Concentration of the solution and explain the nature of the curve. 3

(c) Define Einstein. At 500 nm the energy absorbed by a sample is 60 W. How many photons does the sample absorb in 1 min? 1+2

(d) Explain pre-dissociation with a properly labelled potential energy diagram. 3

UNIT-III

5. (a) "Unimolecular process are always not first order" — Justify the statement using Lindemann mechanism. 2

(b) Explain the following: 2+2

(i) Adsorption is accompanied by decrease in enthalpy and entropy of system.

(ii) Easily liquefiable gases are adsorbed to a large extent.

(c) Show that when a diatomic gas gets adsorbed as atoms on the surface of solid, the Langmuir adsorption isotherm becomes 3

$$\theta = \frac{\sqrt{K_P}}{1 + \sqrt{K_p}}$$

where the symbols have their usual meanings.

(d) What will be the pressure inside a soap bubble of radius 0.1 mm kept in air? [Given surface tension of soap water is 150 dynes/cm and atmospheric pressure is 76 mm of Hg]. 3

(e) At 0ºC and at a pressure of 1 atm only 0.20 fraction of the surface of a finely divided nonporous solid was covered by CO. Find out ΔG^o of the adsorption process at 0ºC. 2

6. (a) Electroosmosis is a consequence of existence of electrical double layer at the solid-liquid interface — Justify. 2

 (b) "Adsorption of a gas on solid is exothermic" — Justify or criticize. 2

 (c) Define with an example, a lyophilic colloid. How many such a colloid help in stabilizing a lyophobic colloid like a *gold sol*? Explain what do you mean by the term 'gold number'. 3

 (d) Why do electrolytes increase the surface tension of a liquid? Explain, with the help of Gibbs adsorption isotherm. 2

 (e) Find the change in surface energy when two identical Hg droplets of diameter 2 mm merged isothermally to form one drop [Surface tension of Hg is 490 dynes cm^{-1} at that temperature] 3

 (f) For a soap solution $\gamma = \gamma_0 - bc$. Derive the corresponding equation of state of the adsorbed film by assuming Gibbs adsorption isotherm. 2

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 6th Semester Examination, 2022

CEMADSE04T-CHEMISTRY (DSE3/4)

GREEN CHEMISTRY

Time Allotted: 2 Hours   Full Marks: 40

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Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.

Answer any *three* questions taking *one* from each Group

GROUP-A

(Unit 1 & 2)

1. (a) What is the main objective of green chemistry? Why catalytic reagents are preferred over stoichiometric reagents?   2+2

   (b) Calculate Atom Economy of the following reaction.   2
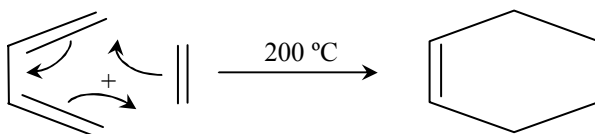
   (c) What are the basic differences between microwave heating and conventional heating?   3

   (d) Why the use of blocking reagents is not preferred in green chemistry?   2

   (e) What is CED (Cohesive Energy Density)? How do the Hydrophobic effect and Hydrogen bonding help to explain the organic reactions in water?   2+4

   (f) Define Fluorous Biphasic Solvent with example. What is asymmetric catalysis?   3+2

2. (a) Write any three Principles of Green Chemistry.   3

   (b) Calculate Atom Economy of the following reaction: 2

   $$MeCH_2CH_2OH + H_2SO_4 = MeCH = CH_2 + H_2O$$

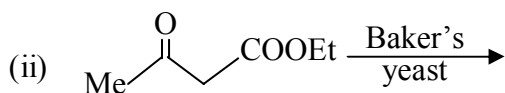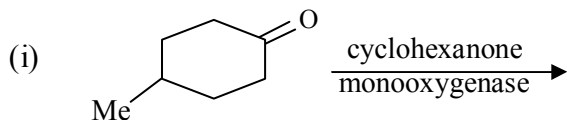   (c) Write short notes on the following: 3×3

      (i)   Homogeneous and Heterogeneous catalyst

      (ii) Solventless Process

      (iii) Supercritical CO_2 as Green Solvent

   (d) What is the meaning of ISD? Explain with examples.   2+2

   (e) How does Ionic Liquid facilitate transition metal catalyzed reaction?   2

   (f) What is Sonochemistry?

GROUP-B

(Unit 3)

3. (a) Write the names of two natural polymers. Write their chemical constitution.   2+2

   (b) Describe the synthesis of Iminodiacetic acid (IDA) developed by Monsanto agricultural company.   3

   (c) What are the advantages of CO_2 cleaning?   3

4. (a) Write short notes on: $3 \times 2 = 6$

     (i) Biofuels

     (ii) Green Synthesis of Catechol.

   (b) What are the differences between pigments and dye?   4

GROUP-C

(Unit 4)

5. (a) Mention the advantage(s) of enzyme catalyst.   2

   (b) Define the term Bio mimetic with suitable example.   3

   (c) Identify the products in the following reactions. $1\frac{1}{2} \times 2 = 3$

     (i)   4-methylcyclohexanone $\xrightarrow{\text{cyclohexanone monooxygenase}}$

     (ii)   ethyl acetoacetate (Me—CO—CH$_2$—COOEt) $\xrightarrow[\text{yeast}]{\text{Baker's}}$

6. (a) What are Multifunctional Reagents? Give Example of two organic reactions using Multifunctional Reagents.   2+2

   (b) What is the role of oxidation catalyst in Green Chemistry?   2

   (c) How Green Chemistry helps in sustainable development?   2

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WEST BENGAL STATE UNIVERSITY
B.Sc. Honours 6th Semester Examination, 2022

CEMADSE05T-CHEMISTRY (DSE3/4)

INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

Time Allotted: 2 Hours   Full Marks: 40

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All symbols are of usual significance.

Answer any *three* questions taking *one* from each group

GROUP-A
(Unit 1 and 2)

1. (a) What is CAN fertilizer? Write down its method of preparation, two properties and two uses. 1+2+2+2

   (b) Write down the structure and two uses of carbon fibres. 2+1

   (c) Give a brief description on coloured glass and photosensitive glass. 2+2

2. (a) What is mixed fertilizer? Write down its advantages. 1+2

   (b) Discuss about the three general properties of ceramics. 2

   (c) Write a short note on carbon nanotubes. 3

   (d) Write down the main ingredients of cement with their functions. 2+4

GROUP-B
(Unit 3, 4 and 5)

3. (a) What are the main objectives of coating surfaces? 3

   (b) Briefly describe the processes of eco-friendly and plastic paintings. 4

   (c) What are enamels and emulsifying agents? 4

   (d) Briefly describe the process metal spraying and anodizing. 3

   (e) What are the differences between water and oil paints? 2

4. (a) How will you define primary and secondary batteries? 4

   (b) Write down the working functions of fuel cell and solar cell. 4

(c) What are ferrous and non-ferrous alloys? 4

(d) Write down the composition and properties of different types of steel. 4

GROUP-C
(Unit 6 and 7)

5. (a) Discuss the elementary steps for heterogeneous catalysis. 3

   (b) Negative catalysts are not catalysts — Comment. 2

   (c) Organic nitro-compounds are very often explosive in nature — Explain. 2

   (d) Give an example of secondary explosive. How is it prepared? 3

6. (a) Give an example of each of solid and liquid propellant. 2

   (b) Discuss the industrial applications of catalysts. 3

   (c) Discuss the preparation of lead azide. How is it stored? 3

   (d) What do you mean by deactivation of catalysts? 2

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 6th Semester Examination, 2022

CEMADSE06T-CHEMISTRY (DSE3/4)

POLYMER CHEMISTRY

Time Allotted: 2 Hours   Full Marks: 40

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Answer any *three* questions taking *one* from each group

GROUP-A

(Unit 1, 2 and 3)

1. (a) What is meant by constitutional repeating unit (CRU) of a polymer? Demonstrate, how it differs from repeating unit using polyethylene as an example.   1+2

    (b) What is functionality factor? Assuming a value of 0.999 for *p* (extent of reaction), what would be the DP of a polyester prepared from equimolar quantities of difunctional reactants in the presence of 1.5 mol% of acetic acid? Let the mol% difunctional reactants both be 98.5.   1+3

    $$[\text{Given, } DP = \frac{2}{2 - pf_{avg}}]$$

    (c) Differentiate between suspension polymerization and emulsion polymerization.   2

    (d) Show that for cationic polymerization rate of propagation is proportional to the square of monomer concentration (if the termination occurs via simple dissociation of the macro carbocation gegenion complex).   4

2. (a) Explain, why nylon 6,6 has a higher melting temperature than nylon 6,10. What is meant by cohesive energy density of a polymer?   2+1

    (b) Derive Carothers' expression relating average functionality, extent of reaction and degree of polymerization for polycondensation reaction carried out for a time period t.   3

    (c) What is the role of inhibitor in free radical polymerization? The following are data for the polymerization of styrene in benzene at 60ºC with benzoyl peroxide as the initiator. $[M] = 3.34 \times 10^3$ mol/m^3, $[I] = 4.0$ mol/m^3, $k_p^2/k_t = 0.95 \times 10^{-6}$ m^3/mol-s. If the spontaneous decomposition rate of benzoyl peroxide is 3.2×10^{-6} s^{-1}, calculate the initial rate of polymerization.   3

    (d) Show that for a self catalyzed polyesterification reaction of a glycol and a dicarboxylic acid (assume equimolar presence of two components) plot of $1/(1 - p)^2$ vs time is a straight line. [*p* is the extent of reaction].   4

GROUP-B
(Unit 4, 5, 6 and 7)

3. (a) Outline the factors on which the degree of crystallinity of a polymer depends.   2

    (b) Explain, why atactic polystyrene is amorphous while the isotactic variety is semi crystalline.   2

    (c) Schematically represent how specific volume changes at glass transition temperature (T_g). Briefly describe, how the volume changes inside a polymer when the glass transition temperature is crossed.   2

    (d) What do you mean by polydispersity index (PDI)? How PDI is significant in polymer study?   2

    (e) The following data were obtained in the determination of average weight of a polymer,   4

Molecular weight	Weight (g)
80,000	1.0
50,000	3.0
30,000	5.0
10,000	6.0

       Calculate, (i) Number average molecular weight M_n (ii) Weight average molecular weight M_w and (iii) Polydispersity index.

    (f) What is polymorphism? Name a polymer which exhibits polymorphism.   2

4. (a) Discuss in brief, the theory underlying the determination of viscosity average molar mass of a sample of polymer by measurement of viscosity.   3

    (b) Discuss why polymers crystallize in a chain folded fashion rather than the thermodynamically preferred extended chain form.   3

    (c) Osmotic pressure measurement of a polymer solutions at 27ºC yielded a plot of π/C vs C, which on extrapolation to zero concentration gave an intercept with ordinate equal to 3.47×10^{-4} litre atmosphere/g. What is the molecular weight of the polymer?   3

    (d) (i) What is the major difference between glassy state and molten state of a polymer?   1

       (ii) Why is glass transition temperature, T_G referred as a second order transition?   2

    (e) Explain, why insertion of rigid bulky groups, like aromatic rings in linear aliphatic polymer chains significantly enhance their physical properties.   2

GROUP-C
(Unit 8 and 9)

5. (a) Using Flory-Huggins theory for polymer solution, deduce an expression for the entropy of mixing.   5

    (b) Write short note on (any *two*):   3+3

       (i) Polyacrylamide, (ii) Novalac resin, (iii) Poly (vinyl acetate)

    (c) Describe the synthesis of polyaniline.   2

6. (a) What do you mean by Hildebrand solubility parameter (δ)? Under what condition (with reference to δ) solubility becomes an entropy effect?   2

(b) How the Flory-Huggins parameter (χ_{12}) is related to Hildebrand solubility parameters δ_1 and δ_2?   2

(c) How can you prepare polyurethanes commercially? Explain, why the melting point of polyurethane is much less than that of the corresponding polyamide.   3

(d) What are polycarbonates? How can you prepare a polycarbonate using bisphenol-A and diphenylcarbonate?   3

(e) What do you mean by synthetic metal? Mention two conditions for a polymer to be conducting.   3

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INORGANIC CHEMISTRY-V

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Answer any *three* questions taking *one* from each unit

Unit-I

1. (a) What are trace elements? Write the analytical techniques that are used to determine these. How chelation therapy may be applied to remove Pd-toxicity from body?   1+2+2

    (b) Show the mechanism of the catalytic hydration of CO_2 by carbonic anhydrase.   3

    (c) Draw the structure of 4Fe-4S ferredoxin and describe its e-transport.   3

    (d) Explain the metal ion transport across bio-membranes with reference to the function of Na^+/K^+ pump (mention the inside/outside concentration of Na^+ and K^+ in a typical cell and its necessity).   3

    (e) State the name and structural form of two gold drugs.   2

2. (a) What are the effects of As-toxicity in human body? Discuss a method of its removal by chelation therapy.   3

    (b) Give the active site structure of O_2-transport Heme protein Hemoglobin. What is Bohr effect? Explain.   3+2

    (c) What is the function of cytochrome-C?   1

    (d) Write and explain the light and dark phase reactions related to photosynthesis.   4

    (e) Discuss the biological role of Ca^{2+} and Mg^{2+}.   3

Unit-II

3. (a) Using 18-electron rule, find the value of '*n*' in ($\eta^5 - C_p$)Co(CO)$_n$.   2

    (b) Explain why the reactivity of bent and linear nitrosyls is different.   2

    (c) What happens when propylene is treated with $Co_2(CO)_8$ and H_2? Give mechanism.   3

    (d) Why ferrocene cannot undergo nitration reaction similar to that of benzene? How is nitro ferrocene prepared?   3

    (e) Applying 18-electron rule deduce the structure of $Fe_3(CO)_{12}$. Show the different modes of bonding of CO in this structure. How would you distinguish them experimentally?   4

(f) What is Fischer-Tropsch process? | 2

4. (a) How will you prepare Zeise's salt from K_2PtCl_6? Discuss the structure and bonding in Zeise's salt. | 2+3

(b) What products do you expect if $H_2C=CH_2$ and $CH_3-HC=CH_2$ are separately treated with Ziegler-Natta Catalysis? | 2

(c) Write the advantages of using Rh-catalyst in place of Co-catalyst in hydroformylation reaction. | 2

(d) The ν_{C-O} of isoelectronic hexacarbonyls is given below. Explain their trends. ($\nu_{C-O}=2143$ cm^{-1} in free CO). | 3

$[Ti(CO)_6]^{2-}$ ($\nu_{C-O}=1748$ cm^{-1}), $[V(CO)_6]^{-}$ ($\nu_{C-O}=1860$ cm^{-1}).

$[Cr(CO)_6]$ ($\nu_{C-O}=2000$ cm^{-1}), $[Fe(CO)_6]^{2+}$ ($\nu_{C-O}=2200$ cm^{-1}).

(e) Between $Rh(PEt_3)_3Cl$ and $Rh(PPh_3)_3Cl$ which one is suitable for Wilkinson's type catalyst for hydrogenation of olefins? Explain. | 2

(f) Acetylation of ferrocene produces only one major product. Explain why. | 2

Unit-III

5. (a) What is trans effect? How can you synthesize any two isomers of $[Pt(Br)(Cl)(NH_3)(Py)]$ from $PtCl_4^{2-}$? | 2+3

(b) What is a labile complex? For what value of 'n' of d^n configuration do we obtain labile complexes and why? | 3

6. (a) How would you proceed to prepare *cis*- and *trans*-$[Pt(NH_3)(NO_2)Cl_2]^{-}$ from $[PtCl_4]^{2-}$ in two step — using NH_3 and NO_2^{-}? | 2+2

(b) In the series Ni(II), Pd(II) and Pt(II), only Pt(II) shows significant trans effect. Justify. | 2

(c) What do you mean by Thermodynamic and Kinetic stability? Explain. | 2

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CEMACOR14T-CHEMISTRY (CC14)

PHYSICAL CHEMISTRY-IV

Time Allotted: 2 Hours

Full Marks: 40

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Answer any *three* questions taking *one* from each unit

UNIT-I

1. (a) Draw schematically the Potential energy diagram of an anharmonic oscillator indicating hot band transition and dissociation energy. For HF molecule with anharmonicity constant 0.0218 and equilibrium oscillation frequency of 2990 cm^{-1}, find the vibrational quantum number at the dissociation level. — 4

    (b) The rotational Raman spectra of $^{35}Cl_2$ has a spacing of 2.94 cm^{-1} between the 1st Stokes and Anti-Stokes line. What will be the bond length of the molecule? How will the spacing change on replacing Cl by its heavier isotope? — 3

    (c) State the difference between NMR and ESR spectroscopy in terms of (i) population ratio of the two levels (ii) line frequency. — 3

    (d) The most intense line of a rotational transition of HCl is the 10 to 11 transition at 25°C. Will the position of this line change on (i) replacing H by D (ii) increasing the temperature. — 4

2. (a) The first vibrational transition of $^1H^{35}Cl$ is 2886 cm^{-1}. Calculate the wave number for the same transition in CO taking the force constant to be 20% higher than that for HCl. Also calculate the ratio of the zero-point energy for HCl to that of CO. — 2+2

    (b) The difference in population between the α and β spin states of an electron in ESR spectroscopy is very low. But the system does not saturate. Explain why? — 2

    (c) Predict the intensity distribution in the hyperfine splitting lines of the ESR spectrum of the radical CD_3 (I = 1 for D). — 3

    (d) Will the frequency of rotation of the molecules $^1H^{35}Cl$ and $^2H^{35}Cl$ differ in the (i) ground state (ii) 1st excited state? — 3

    (e) How does the infrared spectrum of a molecule differ in case of a harmonic and an anharmonic oscillator model? — 2

UNIT-II

3. (a) How will the molar absorbance of a sample at a particular wavelength change if the solution is half diluted and the path length is doubled? Will its value change with the change in wavelength of the incident light?   3

(b) Draw the $1/\Phi$ vs [M] plot for the reaction $A \rightarrow B + C$ having the following mechanism and indicate the value of slope, and intercept.   3

   (i) $A \xrightarrow{\ hv\ } A^*$

   (ii) $A^* + M \xrightarrow{\ k_1\ } M + A$

   (iii) $A^* \xrightarrow{\ k_2\ } B + C$

(c) Name the processes involved in singlet to singlet and singlet to triplet transition. Which of these processes will be enhanced in presence of iodine atom in the system?   3

(d) In a photochemical reaction $A \rightarrow 2B + C$, the quantum yield with 500 nm light is 2.1×10^2. If 2.28 moles of B is formed upon exposure to light, how many photons were absorbed by A?   3

4. (a) For a particular cell, E at 20ºC, 25ºC and 30ºC are 0.0663V, 0.06839V and 0.07045V respectively. Calculate ΔG, ΔS and ΔH for the reaction at 25ºC.   5

(b) The absorption spectra of O_2 shows a vibration structure with continuum at 56876 cm^{-1}. The upper electronic state dissociates into one ground state and one excited state atom (Excitation energy of atom is 15875 cm^{-1}). Estimate the ground state dissociation energy of oxygen in KJ/mole. Explain your answer with proper diagram.   2+2

(c) Name the phenomenon where an electronic spectra gives a continuum in-between two regions of line spectra.   1

(d) The photochemical reaction $SO_2 + Cl_2 \rightarrow SO_2Cl_2$, $\Phi = 1$. Will the rate of this reaction be temperature dependent? Explain your answer.   2

UNIT-III

5. (a) Define surface excess. Derive Laplace's equation of excess pressure inside a spherical bubble, suspended in air.   1+3

(b) Justify/criticize: When work of adhesion is greater than half of the work of cohesion, wetting occurs.   3

(c) Using Stern model of electric double layer, describe zeta potential of a colloidal system. How is zeta potential and coagulation affected by adsorption of oppositely charged ions on the colloidal surface.   4

(d) A quartz particle of diameter 1×10^{-14} cm in aqueous suspension at 25ºC ($\eta_w = 0.8903 CP$) migrate with a velocity of 3×10^{-3} cm/sec under an applied potential gradient of 10 V/cm. Calculate the zeta potential. (Given, the dielectric constant of water is 78.30)   3

6. (a) Show that for a heterogeneously catalysed unimolecular gas phase reaction, the plot of 1/rate vs 1/P, yields a straight line where P is the pressure of the gaseous reactant. Find the value of slope and intercept of the plot.   4

(b) Using thermodynamics show that physisorption is preferred at low temperature.   2

(c) A small hollow sphere with a small hole is immersed in water at a depth of 40 cm before any water penetrates into it. Find the radius of the hole if $\gamma = 73$ dyne/cm.   2

(d) State the differences between lyophilic and lyophobic sols in terms of (i) viscosity of the dispersion medium (ii) nature of stabilization (iii) coagulation.   3

(e) From the BET plot of adsorption of N_2 gas on 1 g of activated charcoal, the intercept and the slope are found to be $1.73 \times 10^{-2} \, cc^{-1}$ and $1.5 \times 10^{-4} \, cc^{-1}$ respectively at NTP. Find volume of the adsorbed monolayer (v_m). If area of a single N_2 molecule is $0.525 \, nm^2$, calculate the area of activated charcoal involved in adsorption.   3

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 6th Semester Examination, 2021

CEMADSE04T-CHEMISTRY (DSE3/4)

GREEN CHEMISTRY

Time Allotted: 2 Hours

Full Marks: 40

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.

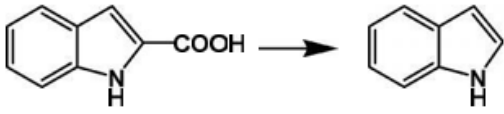**Answer any *three* questions taking one from each Group**

GROUP-A

(Unit 1 & 2)

1. (a) What is the working definition of Green Chemistry? Write two suitable alternative names of Green chemistry.   2+2

    (b) How does atom economy of a reaction differ from its yield? Which of the following methods for the preparation of isobutene has greater atom economy? Calculate and explain your choice.   2+4
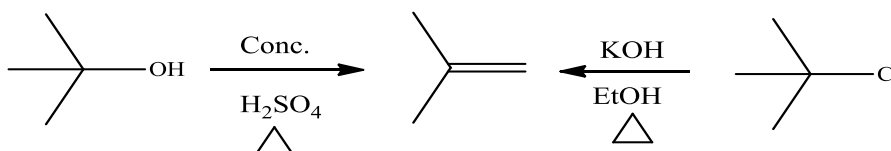

    (c) What is ionic liquid (IL)? Mention one method of preparation of ionic liquid. Why is it regarded as a green solvent?   2+2+2

    (d) What is supercritical fluid? Why is carbon dioxide commonly used as a supercritical fluid? State one of the main drawbacks of sc CO_2.   1+2+1

    (e) What is biocatalyst? Give one example.   2

2. (a) What is Renewable feedstock or Resources? Explain with suitable example(s).   3

    (b) Microwave energy is too weak to break a chemical bond, still microwave-assisted reactions occur faster than conventional reactions. Explain why.   3

    (c) Write short notes on the following: 3×3

         (i) PEG (Polyethylene glycol)

         (ii) Ultrasonic energy

         (iii) Mechanochemical reaction.

    (d) What is carbaryl? Mention its use. Outline one green and one non green method for the preparation of carbaryl.   1+1+3

    (e) What is On-water reaction? Explain with suitable example(s).   2

GROUP-B

(Unit 3)

3. (a) What is Elutriation? Between polyvinyl chloride and polyethylene, which one do you think to be safer and cost-friendly for the manufacturing of carpets? Explain your answer. — 1+2

   (b) Write notes on the following topics: — $2\frac{1}{2} \times 2$

   (i) Green synthesis of catechol

   (ii) Safe Marine antifoulants.

   (c) What are the advantages of enzymatic interesterification over chemical interesterification? — 2

4. (a) Using Greener route how can you do the following conversion (any *two*). — $2\frac{1}{2} \times 2$

   (i)

   (ii) **Glucose to Adipic acid**   (iii) **Corn to Polylactic acid**

   (b) What are the advantages of CO_2 cleaning? — 3

   (c) What is a greener process to generate hydrogenated oil? — 2

GROUP-C

(Unit 4)

5. (a) Explain the concept of 'Solventless Reaction' in 'Green Chemistry' with at least two suitable examples. — 4

   (b) What are co-crystals? How do co-crystals facilitate a reaction? — 2+2

6. (a) Mention the advantages of enzyme catalysis. — 2

   (b) Define the term 'Bio mimetic' with suitable example(s). — 3

   (c) Identify the products in the following reactions: — $1\frac{1}{2} \times 2$
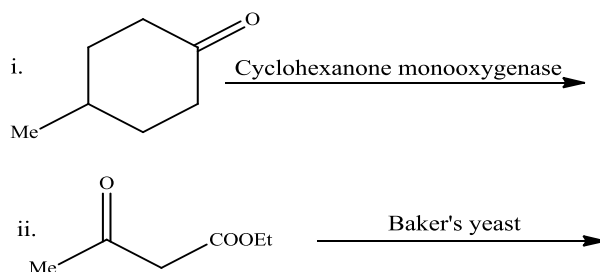
   i.

   ii.

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 6th Semester Examination, 2021

CEMADSE05T-CHEMISTRY (DSE3/4)

INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

Time Allotted: 2 Hours   Full Marks: 40

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.

Answer any *three* questions taking *one* from each group

GROUP-A

(Unit 1 and 2)

1. (a)	What is the general composition of glass? Give a flow diagram of the manufacturing process of glass.	1+3
(b)	What is SWCNT? Name different types of SWCNT. Write two uses of carbon nanotube.	3
(c)	Distinguish between Vitrification and Glazing of Ceramics.	3
(d)	What is direct fertilizer? Give an example.	2
(e)	What do you mean by quick setting cements?	2
2. (a)	What is feldspar? Write its two properties.	2
(b)	Give two examples of superconducting oxides. What are the uses of superconducting oxides?	2
(c)	Describe what do you understand by high technology ceramics and state their application.	3
(d)	Briefly describe the process of manufacturing ammonium phosphate and superphosphate fertilizers.	3
(e)	Write down the composition of borosilicate glass.	2
(f)	Comment on the conducting nature of C_{60} fullerene.	2

GROUP-B

(Unit 3, 4 and 5)

3. (a)	Discuss the main constituents of Li-ion battery.	3
(b)	Write down the difference between primary and secondary battery.	2
(c)	How will you classify steels based on their carbon content?	2

(d) What is the composition of Ferritic stainless steel? Write down the uses of Stainless steel. 2

(e) Briefly describe the process of metal spraying and anodizing. 2

(f) What are the differences between water and oil based paints? 2

(g) What are additives? How are they classified according to their function? 3

4. (a) Discuss the characteristics of a good paint. 3

(b) Give a brief description of the working procedure of Pb-acid battery. 3

(c) Write down the working functions of fuel cell and solar cell. 3

(d) What are ferrous and non-ferrous alloys? 3

(e) Write a short note on Carburizing. 2

(f) What is solid state electrolyte battery? Give one use of it. 2

GROUP-C

(Unit 6 and 7)

5. (a) What are the advantages of heterogeneous catalysis over homogeneous catalysis? 3

(b) What is phase transfer catalyst? Explain. 2

(c) What is TON? Explain. 3

(d) What is meant by regeneration of catalysts? 2

6. (a) What are Zeolites? Give two examples. 3

(b) Catalyst cannot change the value of equilibrium constant — Justify. 2

(c) How is RDX prepared? Give its synthetic route. 3

(d) Write a short note on rocket propellants. 2

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 6th Semester Examination, 2021

CEMADSE06T-CHEMISTRY (DSE3/4)

POLYMER CHEMISTRY

Time Allotted: 2 Hours   Full Marks: 40

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

Answer any *three* questions taking one from each group

GROUP-A
(Unit 1, 2 and 3)

1. (a) 'All polymers are macromolecule but all macromolecules are not polymer'. Explain with example.   2

   (b) Write the structural formula of the polymer having the following IUPAC names   2

   (i) poly[oxy(1-oxohexane-1, 6-diyl)]

   (ii) poly[oxy(1-methylethylene)]

   (c) Derive an expression for p(extent of reaction) for a system with a functionality f and show that when average degree of polymerization (D_p) goes to infinity, $p = 2/f$.   3

   (d) Give examples of any two commonly used initiators in anionic polymerization.   2

   (e) Show that molecular weight of polymer synthesized by cationic polymerization process is independent of the concentration of the initiator.   4

2. (a) Define homopolymer and copolymer with an example. Mention two factors which influence monomer reactivity ratio in copolymerization.   2+1

   (b) How are polymerization processes classified according to Flory and Carothers? Derive and justify that a large enhancement in number average degree of polymerization $\langle x_n \rangle$ value is observed, as the reaction proceeds to completion.   2+2

   (c) Describe the importance of water in emulsion and suspension polymerization. Is water a solvent?   2

   (d) Derive an expression for the rate of propagation for chain growth polymerization in terms of monomer and initiator concentration.   4

GROUP-B
(Unit 4, 5, 6 and 7)

3. (a) Discuss how the structure of a polymer crystal is characterized experimentally.   3

   (b) Differentiate between elastomer and fibre with example.   3

   (c) A solution contains equal masses of two substances with molar masses 10000 g mol^{-1} and 20000 g mol^{-1} respectively. Calculate $\overline{M}_n$ and $\overline{M}_w$.   2

   (d) Discuss in brief the methodology of determination of molar mass of a polymer using osmotic pressure measurements.   3
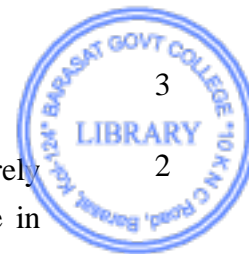
(e) Mention and explain the thermal transitions observed in a polymer. 3

4. (a) Explain why linear polyethylene with crystalline melting point, $T_m = 135°C$ rarely dissolves in solvents below 100°C, but nylon-66 with $T_m = 265°C$ can dissolve in solvents, particularly polar, even at room temperature. 2

(b) Why do isotactic polymers have high T_m, degree of crystallinity and tensile strength compared to atactic ones? 2

(c) Why Nylon makes good fibres? Natural rubber and Gutta percha both are naturally occurring polyisoprene but rubber is flexible and Gutta percha is hard. Explain. 3

(d) Define specific and intrinsic viscosity. Using the Mark-Houwink equation for the intrinsic viscosity, $[\eta] = kM^a$, show that viscosity average molar mass of a polymer is $M_v = \left(\frac{\sum_i N_i M_i^{1+a}}{\sum_i N_i M_i}\right)^{1/a}$. 2+3

(e) Give an example of the following polymers: thermoplastics, thermosets, elastomers and synthetic fibers. 2

GROUP-C
(Unit 8 and 9)

5. (a) Determine the entropy change that takes place when mixing 10 g of toluene with 10 g of a polystyrene sample with M_n = 100000 g/mol. Assume the volume of a monomer is approximately the same as a solvent molecule. Molar mass of toluene = 92 g/mol, molar mass of styrene = 104 g/mol. R = 8.314 J/(K mol) 3

(b) Which is more favourable for mixing, a high or low Flory-Huggins parameter? Why? 2

(c) Write short note on 3+3

(i) Polycarbonates, (ii) Poly (vinyl chloride).

(d) Write the structure of polypyrrole and polythiophene. 2

6. (a) Write the expression for heat of mixing in a polymer solution in terms of solubility parameter and explain the terms involved. 2+2

The entropy change of mixing of two components (1 and 2) is given by $\Delta S = -k(N_1 \ln n_1 + N_2 \ln n_2)$, where the terms have their usual significance. How is this equation modified for polymers in the Flory-Huggins equation? Give the mathematical forms of volume fractions.

(b) Write the synthesis, physical properties and uses of Bakelite. 3

(c) Discuss the methodology for the preparation of polystyrene with a flow chart. How is the impact property of polystyrene enhanced? Mention two important uses of polystyrene. 4

(d) What are silicone elastomers? Give an example. 2

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