WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 1st Semester Supplementary Examination, 2021

CEMACOR02T-CHEMISTRY (CC2)

PHYSICAL CHEMISTRY-I

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

Kinetic Theory and Gaseous State

1. (a) At a certain temperature, the speed distribution function depends on the nature of the gas but the energy distribution function is the same for all gases. Justify or criticize. 3

   (b) Define 'mean free path' of a gas molecule. At ordinary temperature and extremely low pressure, the gas molecules collide far more often with the container wall than with one another. — Explain. 4

   (c) For many polyatomic gases, the classical equipartition theorem fails to explain the heat capacity values at low temperatures. — Explain. 3

   (d) Show that the van der Waals equation leads to values of $Z<1$ and $Z>1$, where Z is the compressibility factor, and identify the conditions for which these values are obtained. 3

2. (a) The average speed of a particle in an ideal gas is $\langle v\rangle$. Then show that the number of particles striking a unit area of the wall of the container in unit time is equal to $\frac{1}{4}\frac{N}{V}\langle v\rangle$, where $\frac{N}{V}$ is the number of molecules per unit volume. 4

   Given: $\int_0^\infty xe^{-ax^2}\,dx=\frac{1}{2a}$

   (b) Calculate the average time between collisions for O_2 at 25° C and 1 atm. The diameter of oxygen molecule is 2.4 Å. 3

   (c) The virial equation of state in terms of P is given by 3

   $$Z=1+\frac{1}{RT}\left(b-\frac{a}{RT}\right)P+\frac{a}{(RT)^3}\left(2b-\frac{a}{RT}\right)P^2+\cdots\cdots$$

   At what temperature does the slope of the Z versus P curve (at $P=0$) have a maximum value for the van der Waals gas? What is the value of the maximum slope?

(d) Use the following data to find the value of R: 3

Average speed $< c >$ for an ideal gas at 25° C and 1 bar is 444 ms^{-1}. The molar mass is 32×10^{-3} kg mol^{-1}.

UNIT-II

Chemical Thermodynamics

3. (a) Identify the following systems as open, closed or isolated systems: 3

(i) A system surrounded by a rigid, impermeable and diathermic wall.

(ii) A system surrounded by a non rigid, impermeable and adiabatic wall.

(b) **0.1** mole of a perfect gas with C_v independent of temperature is made to undergo a reversible cyclic process consisting of the following steps: 6

Stage 1 (1 lit, 1 atm) ⟶ Stage 2 (1 lit, 3 atm)

Stage 2 ⟶ Stage 3 (2 lit, 3 atm)

Stage 3 ⟶ Stage 4 (2 lit, 1 atm)

Stage 4 ⟶ Stage 1

Calculate q, W, ΔU for each step and for the complete cycle. [Molar $\mathbf{C_v = 1.5\ R}$]

(c) Verify that the results for the cycle satisfy the first law of thermodynamics. 2

(d) Show that the change of entropy is a measure of unavailable work. 2

(e) An ideal refrigerator works between 0° C and T° C. It freezes 2.0 kg of water at 0° C per hour. At the same time, the total heat output to the room is 200 kcal/hr. Calculate T° C. Latent heat of fusion of water at 0° C = 80.0 cal/gm. 3

4. (a) Justify or criticise the following: 2+2

(i) ΔU is given by the integral $\int C_v\, dT$.

(ii) $\Delta H = Q$ for a process in which pressure is not constant throughout but for which the final and initial pressures are equal.

(b) Show that the work involved in a reversible, adiabatic volume change from V_1 to V_2 of one mol of an ideal gas is given by 4

$$W = \overline{C_v}\, T_1 \left[\left(\frac{V_1}{V_2} \right)^{R/\overline{C_v}} - 1 \right],$$

where T_1 is the initial temperature.

(c) State Kelvin-Planck and Clausius statements of second law of thermodynamics. 3

(d) Consider the following cycle using 1 mol of an ideal gas, initially at 25° C and 1 atm pressure. 5

Step 1: Isothermal expansion against zero pressure to double the volume.

Step 2: Isothermal reversible compression from $\frac{1}{2}$ to 1 atm.

(i) Calculate the value of $\oint \frac{dQ}{T}$.

(ii) Calculate ΔS for Step 1 and Step 2 respectively.

(iii) Show that ΔS for Step 1 is not equal to the Q for Step 1 divided by T.

UNIT-III

Chemical Kinetics

5. (a) A zero-order reaction can never be elementary. Justify or criticize. 2

(b) For the first-order reactions $A \xrightarrow{k_1} B$ and $A \xrightarrow{k_2} C$, show that at any time during the reaction $[B]/[C] = k_1/k_2$. Plot concentration versus time profile of A, B and C when $k_1 = k_2$. 4

(c) The addition of KCl will influence the rate constant of the following reaction at a given temperature. — Justify. 3

$$S_2O_8^{2-} + I^- \longrightarrow \text{Product}$$

(d) Graphically represent the plot of $\log k$ versus pH of a homogeneous acid catalyzed reaction. k is the rate constant. 2

6. (a) 'Unimolecular reactions are not always first-order'. Justify the statement using Lindemann's mechanism. 4

(b) The rate constant of a reaction increases two times when the temperature changes from T K to $(T + 10)$ K, whereas that for another reaction increases three times for the same change in temperature. Find the ratio of their activation energies if they have comparable pre-exponential factors. 3

(c) Show that if A reacts to form either B or C according to $A \xrightarrow{k_1} B$ or $A \xrightarrow{k_2} C$, then E_a, the observed activation energy for the disappearance of A is given by 4

$$E_a = \frac{k_1E_1 + k_2E_2}{k_1 + k_2},$$

where E_1 and E_2 are the activation energies for the first and the second reaction respectively.

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 1st Semester Examination, 2021-22

CEMACOR02T-CHEMISTRY (CC2)

PHYSICAL CHEMISTRY-I

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 unit

UNIT-I

1. (a) The Maxwell speed distribution of molecules at temperature T kelvin is given as $dn = Ac^2 e^{-mc^2/2k_B T} dc$ in the range of speed c to $c + dc$. Find the expression for A. Deduce the unit of A (k_B is the Boltzmann constant). 2+1

   Given: $\int_0^\infty x^2 e^{-ax^2} dx = \frac{1}{4}\left(\frac{\pi}{a^3}\right)^{1/2}$; $(\alpha > 0)$

   (b) Calculate $\gamma (= C_{P,m}/C_{V,m})$ for a non-linear triatomic molecule of an ideal gas. Is your result equally applicable to a non-ideal gas? Justify. 2

   (c) Does a gas obeying an equation of state $P(V_m - b) = RT$ have a critical temperature? Justify. 2

   (d) How does the mean free path and collision frequency of a gas molecule change on increasing the pressure by two times at constant temperature? 2

   (e) At what temperature will oxygen molecules have same average momentum as helium molecules at 27°C? 2

   (f) Why the experimental value of molar heat capacities for polyatomic molecules differs from the theoretical values at room temperature? 2

2. (a) Two gases (molar masses M_1 and M_2) exhibit identical Maxwell speed distribution at temperatures T_1 and T_2 respectively. When is such an observation possible? $1\frac{1}{2}$

   (b) The exponential term in the Maxwell speed distribution law is negative. Does positive sign in it make any sense? Discuss qualitatively (no derivation). $1\frac{1}{2}$

   (c) Derive the formula for root mean square velocity (C_{rms}) of gas molecules using Maxwell's distribution formula. 3

(d) For linear molecules the degree of freedom corresponding to rotation about the molecular axis does not contribute to the total average energy. Justify or criticize. 2

(e) Two flasks A and B have equal volume. Flask-A contains hydrogen gas at 500 K and flask-B contains an equal mass of nitrogen gas at 1000 K. Assume ideal behavior of the gases and compare the mean free paths of the two gases (assume that the collision diameter of nitrogen is twice that of hydrogen). 3

(f) Show that for a gas obeying the equation of state $P(V_m - b) = RT$ the compressibility factor cannot be equal to or less than unity. Justify the significance of the result. 2

UNIT-II

3. (a) In the context of chemical thermodynamics justify the physical significance of the following statement: 'work or heat is always manifested at the boundary of a thermodynamic system'. 2

(b) Derive the relationship $\left(\frac{\partial H}{\partial p}\right)_T = \left[\left(\frac{\partial U}{\partial V}\right)_T + p\right]\left(\frac{\partial V}{\partial p}\right)_T + V$ and justify that $\left(\frac{\partial H}{\partial p}\right)_T = V$ for solids or liquids. 3

(c) Show that for an ideal gas $\left(\frac{\partial S}{\partial T}\right)_P - \left(\frac{\partial S}{\partial T}\right)_V = nR/T$ (stating the appropriate conditions involved therein). 2

(d) In reversible adiabatic expansion of an ideal gas, the volume expansion is exactly compensated by the drop of temperature. Justify or criticize. 2

(e) Derive and explain Clausius inequality. 3

(f) Show that an isochor has greater slope than an isobar on a $T-S$ diagram for a reversible change of state. 2

(g) The latent heat of fusion of ice at 0°C is 1440 cal/mol and the heat capacity of ice is 8.5 cal/mol. Calculate the latent heat of fusion of ice at –20°C. 2

4. (a) Two Carnot engines (having efficiencies η_1 and η_2) are connected in series in a manner that the heat released by the first is absorbed by the second. Prove that the efficiency of this combination is given as $\eta_{net} = \eta_1 + \eta_2 - \eta_1\eta_2$. Comment on the physical significance of the result that $|\eta_{net}| < |\eta_1 + \eta_2|$. 3

(b) Using an appropriate form of thermodynamic equation of state explicitly show that 2

$\mu_{JT} = \frac{V}{C_p}(T\alpha - 1)$ and hence show that $T_i = \frac{1}{\alpha_i}$ where T_i is the inversion temperature and α_i is the coefficient of thermal expansion at T_i (μ_{JT} denotes the Joule-Thomson coefficient).

(c) An ideal gas is made to undergo the following cycle involving the reversible steps 3

(i) isobaric expansion at p_2

(ii) adiabatic expansion to p_1 where $p_1 < p_2$

(iii) isobaric compression at p_2

(iv) adiabatic compression to the initial state.

Represent the cycle on a P vs. V and a T vs. S diagram (provide proper justification of your answer).

(d) One mole of an ideal gas expands isothermally at 27°C from 100 atmospheres to 1 atmosphere pressure. Calculate the work done if the process is carried out 4

(i) irreversibly in a single stage

(ii) irreversibly in two stages when the intermediate pressure is 50 atm

(iii) reversibly.

What conclusion can you draw from the results?

(e) At NTP, 2.8 L of oxygen were mixed with 19.6 L of Hydrogen. Calculate the change of entropy. 2

(f) At 20°C the heat of solution of anhydrous copper sulfate in a large excess of water is – 15,500 cal/mol, and that of copper sulfate pentahydrate is 2,550 cal/mol. Calculate the heat of the following reaction at 20°C. 2

$$CuSO_4\,(s) + 5\,H_2O\,(l) \rightarrow CuSO_4 \cdot 5\,H_2O(s)$$

UNIT-III

5. (a) By measuring the rate constant of a catalyzed reaction how can you experimentally verify whether it is homogeneous catalyzed or not? Explain. 2

(b) At 30°C the half-life for the decomposition of N_2O_5 is 5.5 h and it is independent of the initial pressure of the gas. Comment on the order of the reaction. Calculate (i) the rate constant and (ii) the time required for 90% decomposition. 2

(c) For the consecutive reaction (assume each step to be of first-order) 3

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$

plot the variation of concentrations of different species with time when

(i) $k_1 = 2k_2$

(ii) $k_2 = 2k_1$

(iii) $k_2 = 10k_1$.

(d) Derive Michaelis Menten equation of enzyme catalysis. 4

6. (a) Explain primary kinetic salt effect with examples. 3

   (b) An unimolecular reaction behaves kinetically as first-order in the limit of high pressure and kinetically as second-order in the limit of low pressure. Justify or criticize. 3

   (c) For any reaction rise of temperature will inevitably cause enhancement of reaction rate. Justify or criticize. 2

   (d) For a reaction A ⇌ B ⇌ C, show from kinetic point of view that $\frac{[C]_{eq}}{[A]_{eq}} = \frac{k_1 k_2}{k_{-1} k_{-2}}$. 3

   Here k_1 and k_{-1} are the rate constants for forward and backward reaction of A ⇌ B and k_2 and k_{-2} are the rate constants for forward and backward reaction of B ⇌ C .

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 2nd Semester Examination, 2021

CEMACOR04T-CHEMISTRY (CC4)

ORGANIC CHEMISTRY-II

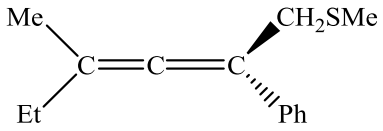
Time Allotted: 2 Hours | Full Marks: 40

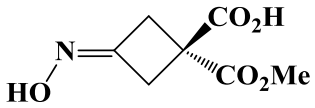
The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

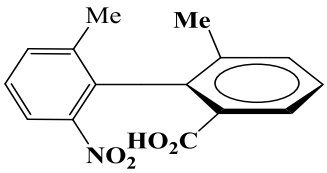
Answer any *three* questions taking *one* from each unit

Unit-I

1. (a) Assign (R/S) configurational descriptors to the following molecules. 1×3 = 3

(i) 

(ii) 

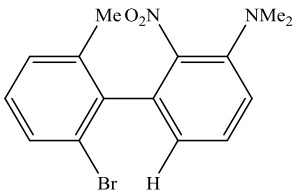
(iii) 

(b) Explain the following observations. 2+2+2

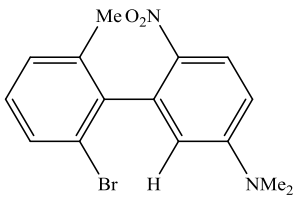
(i) Cyclopentadiene exists only in the *s-cis* form whereas 1,3-pentadiene can exist both in *s-cis* and *s-trans* forms.

(ii) (2R, 3S)-2,3-Dibromobutane is more stable than (2S, 3S)-2,3-Dibromobutane.

(iii) Compound **C** undergoes racemisation at a slower rate than compound **D**.



C



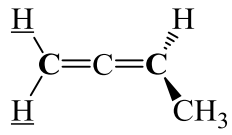
D

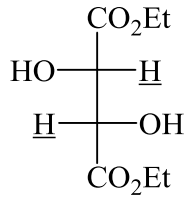
(c) Explain Buttressing effect with an example. 2

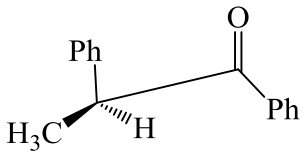
(d) Account for the following observations. 2

Dipole moment of *meso*-1,2-dichloro-1,2-diphenyl ethane is less than that of the active isomer.

2. (a) Find out the topic relationship between the underlined 'H' atoms and the mentioned faces in the following and describe the process by which the relationships are determined. 3+1

(i) 

(ii) 

(iii) 

(Two faces of carbonyl)

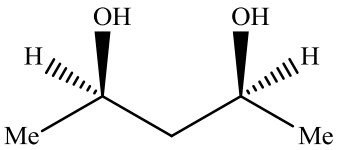
(b) What is the product obtained from the reduction of (2S, 3R)-2,3-dichlorocyclobutanone with $LiAlH_4$ by attack from the *Re* face? 2

(c) What type of stereoisomerism (enantiomerism / diastereomerism) is expected for the following compounds? Explain your answer. 2

(i) MeCH = C = C = C = C = CHEt (ii) PhCH = C = C = C = CHMe

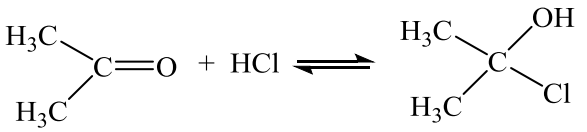
(d) Explain the stereoisomerism of 6,6′-dinitro-diphenic acid and draw the energy profile for racemisation of its enantiomers. 3

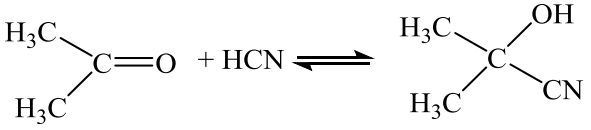
(e) Write down the compound obtained by substitution of *pro-s* hydrogen of the following compound by Cl. Also find out the configuration of the centre at which the substitution is done. 2



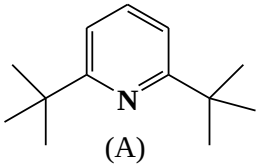
Unit-II

3. (a) Which of the following reaction is thermodynamically more favourable? — Why? 3

i) 

ii) 

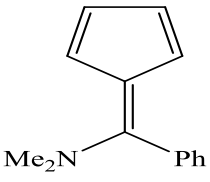
(b) (A) is known as an excellent scavenger of protons. — Explain. 2



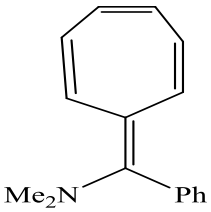
(A)

(c) Treatment of conc. H_2SO_4 with naphthalene yield 1-derivative at low temperature and 2-derivative at higher temperature. Draw the mechanism and energy profile of those reactions. Explain the terms "kinetic controlled" and "thermodynamic controlled" reaction in connection with the above reaction. 2+2

(d) Compare the basic strength of (I) and (II). 2



(I)

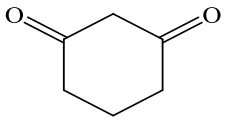


(II)

(e) Explain the following statements. 1+2

(i) Cyclic 1,2-diketones exist mainly in the enol form.

(ii) In aqueous alkali, cyclohexane-1,3-dione (I) is readily soluble, while bicyclo [2.2.2] octane-2,6-dione (II) is poorly soluble.



(I)

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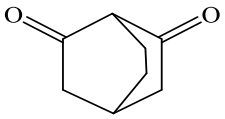


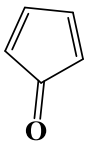
(II)

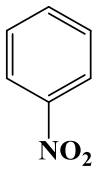
4. (a) Arrange the following compounds in the increasing order of enol content. Explain your answer. 2

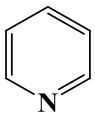
$CH_3COCH_2COCH_3$, $CH_3COCH_2CO_2Et$, $PhCOCH_2COCH_3$ and $CH_3COCH(Ph)CO_2Et$

(b) Compare the basicity with explanation. 4

i) 

and 

ii) 

and 

(c) Compare the acidity of the following compounds 2+2

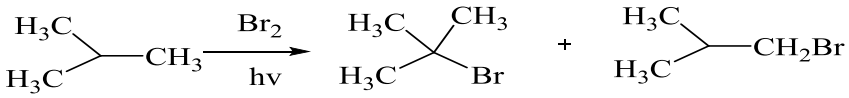
(i) *p*-chlorophenol and *p*-fluorophenol.

(ii) *p*-nitro benzoic acid and *p*-methoxy benzoic acid.

(d) The addition of chlorine (1 mol) to 1,3-butadiene at 25°C produces 60% 3,4-dichlorobut-1-ene and 40% 1,4-dichlorobut-2-ene. At 200°C, the yields are 30% and 70% respectively. Explain these observations with energy profile diagram. 3

(e) What is nucleophilic catalysis? 1

Unit-III

5. (a)  3

Show the mechanism of the reaction and predict the product composition with proper justification.

(b) Explain the following observations. 2×4 = 8

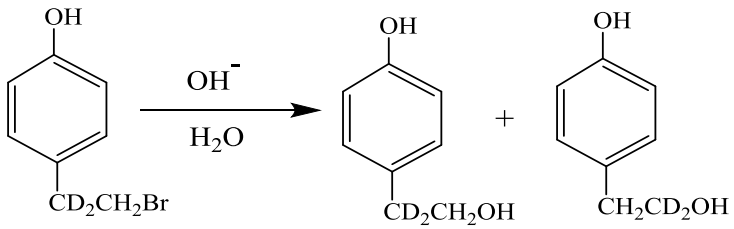
(i) Iodide induced debromination occurs faster for *meso*-2,3-dibromobutane than for its active isomer.

(ii) Potassium permanganate dissolves in benzene in presence of 18-crown-6 to form a purple solution.

(iii) Bromination of propane is more regioselective than chlorination of the same compound.

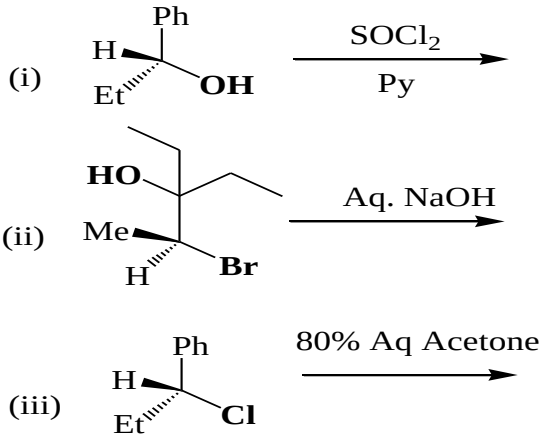
(iv) Rate of the reaction between methyl iodide and NaN_3 at 0°C increases 4.5×10^4 fold when the solvent is changed from methanol to dimethyl formamide.

(c) Account for the following observation. 2



6. (a) When the elimination of HF from 1,1-dichloro-2,2,2-trifluoroethane is carried out with sodium methoxide in CD_3OD, 1,1-dichloro-1-deuterio-2,2,2-trifluoroethane can be recovered from the reaction mixture. How can this result be interpreted for the elimination reaction? Offer an explanation. 2

(b) Identify the product/s in the following reactions with proper stereochemistry and show the plausible mechanisms 2×3 = 6



(c) For the synthesis of CH_3-O-$C(CH_3)_3$, two plausible reaction routes are given below. Find out the favourable reaction route with explanation. 2

Route-I $H_3C—Br + (CH_3)_3COK \longrightarrow$

Route-II $(CH_3)_3CBr + H_2C—OK \longrightarrow$

(d) In the following reaction, the order of nucleophilicity is $I^- > Br^- > Cl^-$ when LiX is used as source of halide ions, but the order is reversed when $Bu_4N^+X^-$ is used. — Why? $1\frac{1}{2}$

$$CH_3CH_2CH_2CH_2OBs + X^- \xrightarrow{\text{Acetone}} CH_3CH_2CH_2CH_2X + BsO^-$$

(e) E2 and $E1_{CB}$ eliminations cannot be distinguished kinetically — Justify the statement. $1\frac{1}{2}$

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 3rd Semester Examination, 2021-22

CEMACOR05T-CHEMISTRY (CC5)

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) To measure the viscosity of a liquid using Ostwald viscometer the Poiseuille equation, which is used, can be expressed as 3

$\eta = A\,\rho\,\Delta t$ where η is the coefficient of viscosity of the liquid, ρ is the liquid density, $\Delta t =$ time of flow of specific volume of the liquid and A is the viscometer constant which depends on the geometry of the viscometer. Find *A*.

(b) In an electrolysis experiment, a current of 0.10 A flows through a solution of conductivity, κ = 0.010 $ohm^{-1}\ cm^{-1}$ and cross-sectional area 10 cm^2. Find the electric field strength applied through the solution. 3

(c) At a certain temperature, the transport number of chloride ion in KCl solution is less than that in HCl solution having same concentration. Explain. 2

(d) A liquid is allowed to fall from a burette. Can Poiseuille's equation be applied in this case? Explain. 2

(e) State the Walden's rule. This rule is more accurate for large ions. — Justify. 2

2. (a) The time of efflux of H_2O through an Ostwald viscometer is 1.52 min. For the same volume of an organic liquid of density 0.800 g/cc the time is 2.25 min. Find the viscosity of the liquid relative to that of water, and its absolute viscosity in millipoises. Experiment was performed at 25°C, at which water viscosity is 0.00089 Pa.s and density is 0.997 g/cc. 3

(b) Give the schematic conductometric titration curve for titration of aqueous solution of sodium acetate by hydrochloric acid conductometrically. Give explanation. 3

(c) Why should equivalent conductance of a weak electrolyte at a finite concentration be less than that at infinite dilution? 2

(d) The conductivity of pure water was estimated to be 0.0384×10^{-6} $ohm^{-1}\ cm^{-1}$ at 18°C. If equivalent conductivity of hydrogen and hydroxyl ions at infinite dilution are 315.2 and 173.8 $ohm^{-1}\ cm^2\ g.eq^{-1}$ respectively at 18°C then find the ionic product of water at that temperature. 2

(e) Liquids of high viscosity have high boiling points and higher heats of vapourisation. Explain. 2

UNIT-II

3. (a) Show that for an open system chemical potential of i^{th} constituent, μ_i, in a mixture can be expressed as $\mu_i = \left(\frac{\partial H}{\partial n_i}\right)_{S,\ P,\ n_{j\neq i}}$ where $H =$ enthalpy of the system. 3+1

Can this μ_i be defined as partial molar enthalpy of the i^{th} constituent? Explain.

(b) Show that if the equation of state for a gas is $p(\bar{V} - b) = RT$, at pressure p, where b is a constant, f is the fugacity of the gas, the relation is given by $f = p \times \exp(bp/RT)$. 3

(c) For a binary mixture of ideal gases, A and B, show by a schematic plot the variation of the Gibbs energy of mixing of the gases (ΔG_{mix}), as a function of mole fraction of A (X_A). Using the expression of ΔG_{mix}, justify the composition at the minimum of the plot. 1+3

(d) In a mixture of 1 part of N_2 to 3 parts of H_2, the mole per cent of NH_3 at equilibrium was found to be 1.20 at 500°C at a total pressure of 10 atm. Calculate the value of the equilibrium constant K_P at that temperature. 3

(e) The value of the equilibrium constant of a given reaction depends on its stoichiometry. Explain. 2

4. (a) Define chemical potential of a constituent 'i' in a homogeneous mixture. Is the chemical potential an extensive or intensive property? Give its SI unit. 1+1+1

(b) Draw the plot of $\ln K_P$ versus $1/T$ of an endothermic reaction with $\Delta C_P = 0$ for the reaction. Mention the importance of such a plot. 2+1

(c) For a given species, transport will occur from a region of high chemical potential to low chemical potential. Justify. 2

(d) In connection to chemical potential of an ideal gas, often we write $\mu = \mu^0 + RT \ln P$ Explain the terms. Is there any dimensional mismatch? Arrive at the dimensionally correct relation. 1+1+2

(e) The value of $K_P(T)$ (based on standard of one bar) for the reaction described by $NH_3(g) \rightleftharpoons \frac{3}{2}H_2\ (g) + \frac{1}{2}\ N_2\ (g)$ is 1.36×10^{-3} at 298.15 K. Determine the corresponding value $K_C(T)$ (based upon a standard state of one mol L^{-1}). 1+3

UNIT-III

5. (a) Prove that the de Broglie wavelength, λ, of an electron accelerated through a potential of V volts is given by 3

$$\lambda = \frac{12.25}{\sqrt{V}}\ \text{Å}\ \ (\text{Å= angstrom})$$

(b) Stopping potential for photo electrons emitted from surface irradiated by light of λ = 3000 Å is 1.91V. What is the new λ for which the potential is 0.9 V. 3

(c) A free particle of mass, *m*, is confined within a cubical box of side, *a*. The potential energy is zero inside the box and infinity elsewhere. If the energy of the particle at an excited level is three times to that at the ground level, then show that the excited level is three-fold degenerate. 3

(d) Calculate the zero-point energy of simple harmonic oscillator. Is your obtained result violating Uncertainty principle or not — Explain. 1+2

6. (a) Assume that a particle is confined to a box of length *a*, and that the system wave function is 1+3

$$\psi(x) = \sqrt{\frac{2}{a}} \sin\left(\frac{\pi x}{a}\right)$$

(i) Is this state an eigenfunction of the position operator?

(ii) Calculate the average value of the position, $\langle x \rangle$ that would be obtained for a large number of measurements. Interpret your result.

(b) Find out $\langle p_x \rangle$ for a harmonic oscillator in its ground energy level, $\psi_0 = (\alpha/\pi)^{1/4} e^{-a x^2/2}$. Will the result remain the same for excited levels? 3

(c) Show that if $\hat{A}$ and $\hat{B}$ are Hermitian then $\hat{A}\hat{B}$ is also Hermitian only if $\hat{A}$ and $\hat{B}$ commute. 3

(d) In the Compton effect while photons are scattered from electrons initially at rest, the Compton shift is maximum when photons are backscattered (θ=180°). Justify. 2

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 3rd Semester Examination, 2021-22

CEMACOR06T-CHEMISTRY (CC6)

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) Find out the limiting radius ratio for octahedral coordination in a close packed lattice. HgS has a radius ratio value of 0.68 but it crystallizes in the Zinc blend structure. Explain. 2+2

   (b) Write down Kapustinskii equation for lattice energy and mention the importance of this equation. 2

   (c) Draw the resonating structures of CNO^- and NCO^- ions showing the formal charge and comment on their relative stability. 2+2

   (d) Explain the following: 2×3

   (i) The dipole moment of carbon monoxide molecule is smaller than expected.

   (ii) HgI_2 is less soluble in water than $HgCl_2$.

   (iii) Melting point of AgCl is 455°C while that of KCl is 776°C though the radii of K^+ and Ag^+ ions are comparable.

2. (a) Using VSEPR theory predict the shapes of $XeOF_4$ and $[ICl_4]^-$. 3

   (b) Calculate the lattice energy of ThO_2 using Born Lande equation. Madelung constant = 2.519, Born exponent for Th^{4+} is 14. Radii are: Th^{4+} = 108 pm and O^{2-} = 126 pm. 3

   (c) $^{\cdot}CH_3$ radical is planar where as $^{\cdot}CF_3$ radical is pyramidal — Explain with Bent's rule. 2

   (d) Differentiate between Schottky defect and Frenkel defect with example. 4

   (e) Cite two examples where the VSEPR theory fails to predict the shape of a molecule. 2

   (f) Explain the solubility trends: 2

   $$MgSO_4 > CaSO_4 > BaSO_4$$

UNIT-II

3. (a) Draw MO diagram for NO molecule. Compare the bond dissociation energies of NO^+ and NO^- species and explain the difference. $3+1\frac{1}{2}+1\frac{1}{2}$

   (b) Distinguish between intrinsic and extrinsic semiconductors with examples. 4

   (c) The sequence of boiling point of the following compounds is: 3

   $NH_3 >> PH_3 < AsH_3 < SbH_3$ — Explain.

   (d) From the view point of MO theory, explain why BeH_2 is a linear molecule. 3

4. (a) Construct the MO diagram for H_2O. Calculate the bond order from it. 4+1

   (b) Addition of antimony with Germanium produces which type of semiconductor. Discuss. 3

   (c) How can you correlate the colour of CdS with the Band Theory? 2

   (d) PH_3 is more volatile than NH_3. — Explain. 2

   (e) From MO theory explain why NO_2^+ is linear but NO_2 is bent. 2

   (f) Explain why the O-O bond length varies as $O_2^+ < O_2 < O_2^-$. 2

UNIT-III

5. (a) What is radioactive equilibrium? How does it differ from chemical equilibrium? 2+1

   (b) Write notes on (any ***one***): 3

   (i) Radio carbon dating, (ii) Uses of isotopes in tracer technique.

   (c) A small amount of radioactive material of half life period 20 days got inadvertently spread in a laboratory making the level of radiation 40 times the permissible safety level. After how many days the laboratory would be safe for use? 2

6. (a) Complete the following artificial transmutations 3

   $_{24}Cr^{50}$ (α,n) ⟶

   $_4Be^9 + {}_1H^1$ ⟶ $+ {}_2He^4$

   $_{13}Al^{27}$ (n,p) ⟶

   (b) Distinguish between nuclear fission and nuclear spallation reaction. 2

   (c) Half life of one radio-element is 231 minute. How long would it take for 9/10th fraction decay of the element? 3

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 3rd Semester Examination, 2021-22

CEMACOR07T-CHEMISTRY (CC7)

ORGANIC CHEMISTRY-III

Time Allotted: 2 Hours | Full Marks: 40

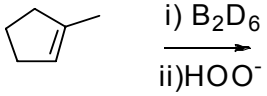
The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

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

UNIT-I

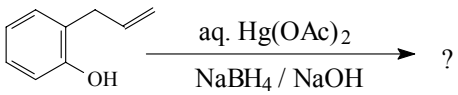
1. (a) Explain showing the mechanism why methyl vinyl ketone readily epoxidizes in presence of alkaline hydrogen peroxide than in presence of a peroxy acid? 2

   (b) Predict the product and explain mechanistically 2

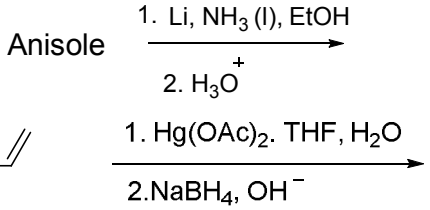


   (c) Starting from *E*-butene, discuss the method of preparation of *meso*-butane-2,3-diol and *dl*-butane-2,3-diol separately? Mention the reagents and stereochemistry of the reactions in each case. 3

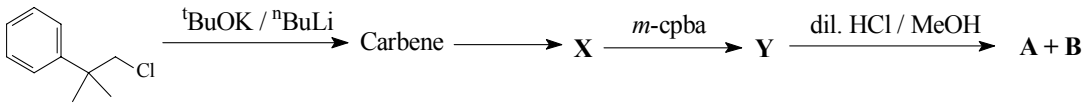
   (d) Predict the product with mechanism indicating the major one in the following reaction: 3



2. (a) Predict the product (with mechanism) of the following reactions 2+2



   (b) Complete the reaction sequences and write down the proper structures of **X, Y, A** and **B.** 4

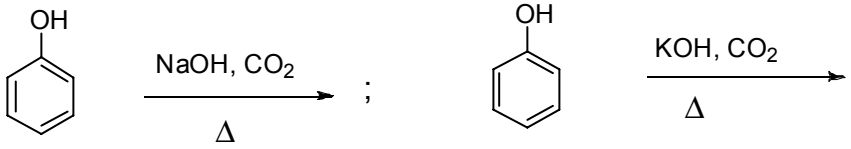


(c) Treatment of $Me_3C\text{-}CH{=}CH_2$ and $Me_3C\text{-}CH(OH)CH_3$ with conc. HCl gives the same two isomeric alkyl chloride. Explain. 2

UNIT-II

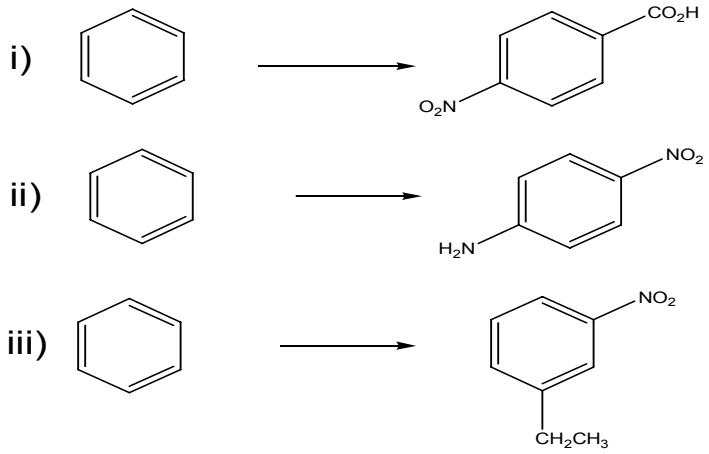
3. (a) Both phenol and aniline give very poor yield in Friedel-Crafts reaction though OH and NH_2 both are activating groups. 2

(b) Predict the product(s) of the following reactions with explanation 2



(c) Both *o*-bromoanisole and *m*-bromoanisole give same product when treated with Na / liq. NH_3. Give reason for this observation. 2

4. (a) Carry out the following conversions: (any ***two***) 2+2



(b) Chlorobenzene on heating with aq. NH_3 at 200°C in presence of catalyst results in formation of aniline. Whereas the same on reaction with $NaNH_2$, NH_3 (l) even at (– 33°C) gives the aniline. Explain mechanistically. 2

UNIT-III

5. (a) It is often necessary to adjust the reaction medium to the right pH in nucleophilic addition to C=O. Explain. 2

(b) Acetylation with acetylchloride requires dry condition but benzoylation is carried out in aq. alkaline solution. Explain. 2

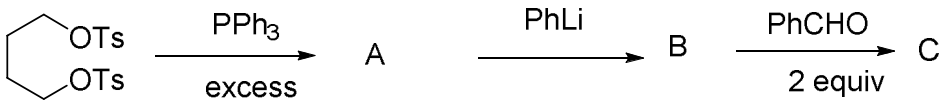
(c) Draw the mechanism of Claisen condensation reaction taking the example of ethylacetate. Between Claisen condensation and aldol condensation which one 3

requires larger amount of base? Explain.

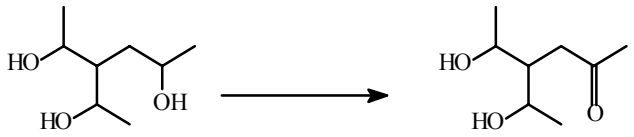
(d) Arrange the following substrates according to their reactivity towards nucleophiles: 2
Me-CO-NMe_2, Me-CO-Cl, Me-CO-SMe, Me-CO-OMe.

(e) Cyclopropanone gives stable hydrate but propanone does not — Why? 2

(f) Identify A, B, and C in the following reaction with mechanism 3

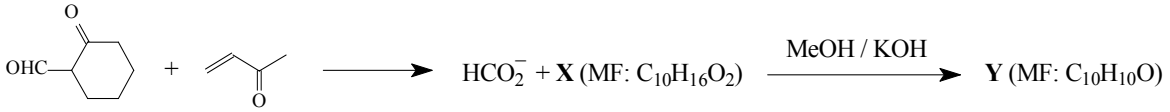


(g) Mention two criteria for a good protecting group. Using protecting / deprotecting group technique outline the following conversion: 2+2



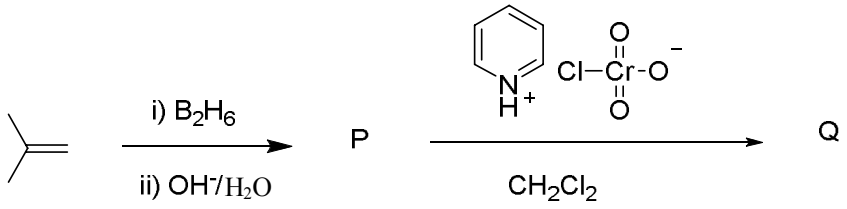
6. (a) Rate of reduction of a ketone by $LiAlH_4$ decreases when crown ether (12-Crown-4) is added to the reaction mixture — Explain. 2

(b) Identify **X** and **Y** in the following reaction sequence and offer mechanistic explanation in support of your answer: 4

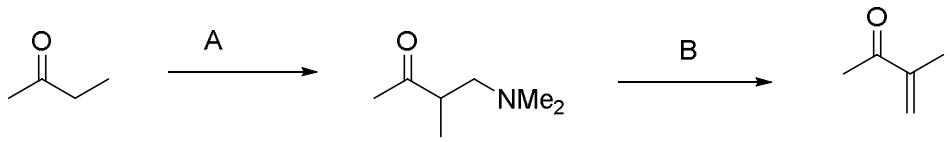


(c) Optically active PhCOCH(Et)Me is racemised on base treatment but $PhCOCH_2CH(Et)Me$ does not — Explain. 2

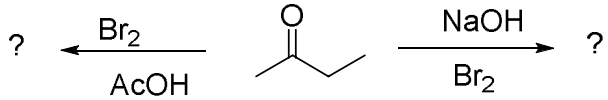
(d) Write down the products P and Q of the following reactions 2



(e) Mention the reagent A and B of the following reaction 2



(f) Predict the products in the following. 2



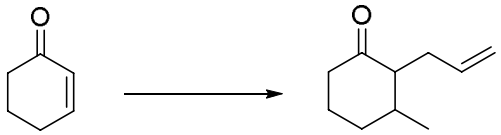
(g) A solution of Ph_3CCO_2H in cold conc. H_2SO_4 affords $MeOCPh_3$ when poured in methanol — Explain. 2

(h) Which of the following compound undergoes decarboxylation reaction more readily? Explain. 2

UNIT-IV

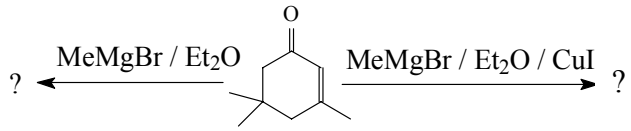
7. (a) How would you prepare ethane utilizing Corey house reagent? 2

(b) Outline the scheme for the following transformation using appropriate organometallic reagent 2



(c) How could you prepare the acid $R_3C\text{-}CO_2H$ from R_3COH? 2

8. (a) Give the products with proper explanations: 2



(b) Mention one synthetic application of TMSCN in organic synthesis. 2

(c) Outline the steps involved for the synthesis of β-phenylethyl alcohol starting from phenyl magnesiumbromide. 2

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 4th Semester Examination, 2021

CEMACOR08T-CHEMISTRY (CC8)

PHYSICAL CHEMISTRY-III

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) Using the concept of chemical potential, derive thermodynamically the relation between the elevation of boiling point of a solvent and molality of the solution. Clearly mention the assumptions and approximations used in the derivation. 3+1

   (b) Liquid carbon dioxide cannot exist at normal atmospheric pressure, whatever be the temperature. — Justify. 2

   (c) The heat of fusion of ice is 6.0 $kJmol^{-1}$. Calculate the freezing point of water in a solution containing a non-volatile nonelectrolyte solute where the mole fraction of water is 0.8. 3

   (d) State the degrees of freedom for an azeotrope in two component liquid-vapour equilibrium. Explain why an azeotropic mixture is not considered to be a compound. 1+1

   (e) Consider the phase transition $H_2O(l) \rightleftharpoons H_2O(v)$ and depict with a graphical representation, the variation of chemical potential of H_2O against temperature at constant pressure in the vicinity of its boiling point. 3

2. (a) Derive Duhem-Margules equation for binary solution stating clearly the assumptions. 3

   (b) Show that the expression of osmotic pressure of a dilute solution is similar to that of an ideal gas. State the assumptions and approximations involved. 3+1

   (c) What do you understand by phase (P), component (C) and degrees of freedom (F) of a thermodynamic system? 3

   (d) A mixture of 100 g water and 80 g of Phenol separates into two layers at 60° C. One layer, $\mathbf{L}_1$, consists of 44.9% water by mass, the other layer $\mathbf{L}_2$, consists of 83.2% water by mass. Calculate the total number of moles in $\mathbf{L}_1$ and $\mathbf{L}_2$. 4

   [Given: molar mass of Phenol is 94.4 g mol^{-1}]

Unit-II

3. (a) What are the factors on which the Debye-Hückel constant (A) depends? 2

   (b) Discuss the principle of standardization of a given Mohr's salt solution by standard potassium dichromate solution. Show the plot of E_{cell} (volt) vs. $N_{oxidant}$, where $N_{oxidant}$ is the number of drops of oxidant. Also calculate $E^0_{Fe^{3+}/Fe^{2+}}$. 3+2+1

(c) For AgI $K_{sp}= 1\times10^{-16}$ at 298 K. What will be the potential of $Ag^+ | Ag(s)$ electrode in a saturated solution of AgI? Also calculate the standard reduction potential of $Ag(s) | AgI(s) | I^-$ electrode at 298 K. Given: E^0 of $Ag^+ | Ag(s) = 0.80$ V at 298 K. 2+2

(d) How does molar polarisation vary with temperature for polar molecules? 2

4. (a) Show schematically the plots of $\log f_{\pm}$ versus $\sqrt{C}$ (where C is the molar concentration) for the dilute aqueous solutions of two strong electrolytes $AlCl_3$ and Na_2SO_4 in the same graph at 298 K and hence show that their slopes are in the ratio $3:\sqrt{2}$. 3

(b) Given that standard potentials of the Cu^{2+}/Cu and Cu^+/Cu couples are + 0.340 V and + 0.552 V, respectively. Evaluate standard potential (E^0) of (Cu^{2+}/Cu^+) system. 3

(c) Set up a reversible cell without transference for the process: 1+1+1

$$CuSO_4\ (a_1) \longrightarrow CuSO_4\ (a_2)\ ;\quad (a_2 < a_1)$$

What is liquid junction potential? How it can be eliminated?

(d) Explain how the pH of a solution can be determined by the use of a glass electrode. 3

(e) If the dipole moment for Chlorobenzene is 1.57 D then find that for *m*-dichlorobenzene. 2

Unit-III

5. (a) Evaluate the following commutators and comment on the results. 2+2

(i) $[L_x,\ L_z]$ (ii) $[L_z,\ L^2]$

(b) (i) Define an orbital. 1+2+1

(ii) Find the number of radial nodes in the wave functions of the following orbitals:

$2p$ and $3s$

(iii) What is the physical significance of a node?

(c) Calculate the probability of finding a1s electron of hydrogen within a distance $2a_0$ from the nucleus. What is the probability beyond $2a_0$? 3+1

6. (a) What is Born-Oppenheimer approximation? 2

(b) Suppose an atom has two electrons in two different orbitals. What will be the values for the total spin quantum number S and the multiplicity? 2

(c) Consider a trial function $\psi = x(a-x)$ for a particle in a one-dimensional box of length a. Show that this function satisfies the boundary conditions. Apply the variation method to get an upper bound to the ground state energy of the particle and compare the result with true value. 4

(d) Under what conditions the mixing between two atomic orbitals would result in a molecular orbital with better combination in LCAO-MO method? Explain qualitatively with suitable examples. 4

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 4th Semester Supplementary Examination, 2021

CEMACOR10T-CHEMISTRY (CC10)

ORGANIC 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 *four* questions taking *one* from each unit

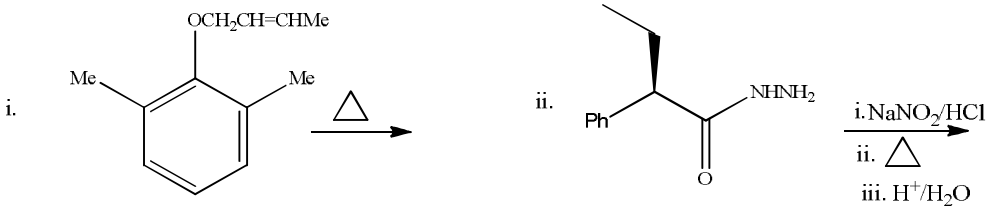
UNIT-I

1. (a) What is Mannich base? 2
   (b) Convert aniline to benzene. 2
   (c) State the action of $NaNO_2$ / HCl on: 1+1
   (i) N-methylaniline (ii) N, N-dimethylaniline

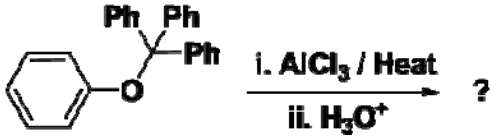
2. (a) How we can generate carbene from diazo methane? 2
   (b) Write short notes on NEF Carbonyl synthesis. 2
   (c) Convert: Phenol ⟶ *p*-aminophenol 2

UNIT-II

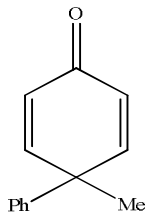
3. (a) "In the Arndt-Eistert synthesis two equivalent of diazomethane is used." — Explain the statement showing mechanism of the reaction. 2
   (b) Predict the products in the following reactions and formulate plausible mechanism for their formation. 2+2



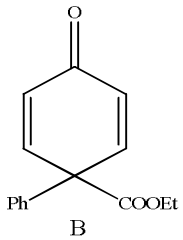
   (c) Explain the following rearrangement reaction in terms of thermodynamically and kinetically control product? 2



4. (a) In the dienone-phenol rearrangement of compound A the phenyl group migrates but in the dienone-phenol rearrangement of compound B the –COOEt group migrates. Account for this observation. 3



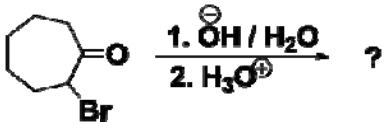
A



B

(b) Show that Hofmann, Curtius, and Lossen reactions proceed through a common intermediate. Give proper evidence in favour of your answer. 3

(c) Predict the product in the following reaction with plausible mechanistic explanation. 2



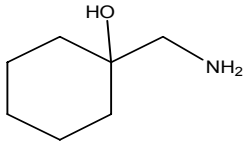
UNIT-III

5. (a) Differentiate between stereoselective and stereospecific reaction with example. 2

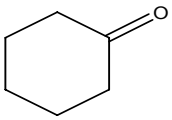
(b) What is meant by 'illogical electrophile' and 'illogical nucleophile'? Give examples. 2

(c) Write down protection and deprotection method of Boc protected amine. 2

(d) Synthesize (A) from (B) using retrosynthetic approach, 2

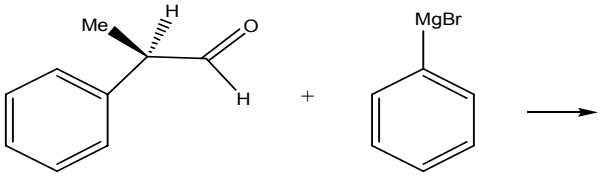


(A)



(B)

(e) Predict the major and minor product. 2

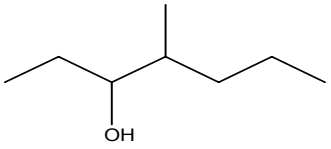


6. (a) Differentiate between diastereoselectivity and enantioselectivity with example. 2

(b) Define the terms disconnection and synthon. 2

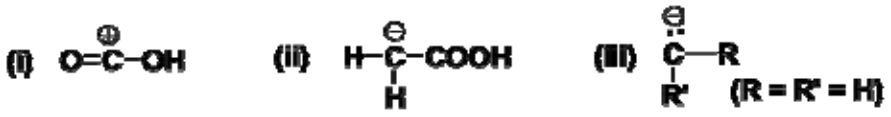
(c) Write down protection and deprotection method of CBz protected amine. 2

(d) Synthesize (I) using retrosynthetic approach. 2



(I)

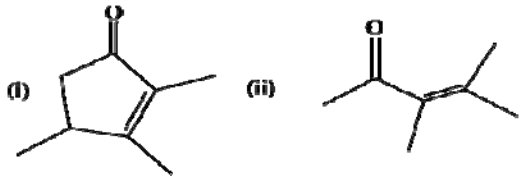
(e) Write down the synthetic equivalents of any ***two*** of the following synthons. 2



UNIT-IV

7. (a) How can you distinguish between anisole and *p*-cresol by UV spectroscopy? 2

   (b) Calculate l_{max} values for the following compounds using Woodward Fieser rule. 2+2



   (c) Why carbonyl stretching frequency in acetone is lower than that in acetyl chloride? 2

   (d) Write down different types of stretching and bending vibrations. 2+2

   (e) A compound $C_4H_6O_2$ shows a very strong IR band at 1720 cm^{-1} and only one singlet signal in its ^1H NMR spectrum. Analyze the compound. 3

   (f) Distinguish *o*-hydroxy benzaldehyde and *p*-hydroxy benzaldehyde by IR spectroscopy. 1

8. (a) A compound of molecular formula $C_6H_{12}O$ shows a very strong IR band at 1705 cm^{-1} and two singlet signals at δ 2.1 and 1.2 in its ^1H NMR spectrum. Analyze the compound. 3

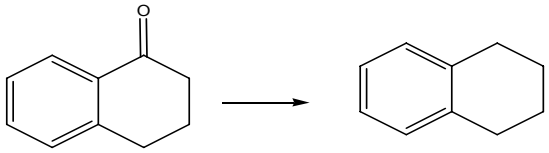
   (b) Differentiate between *o*-dinitrobenzene and *p*-dinitrobenzene by ^1H NMR spectra. 2

   (c) How can you distinguish between cyclohexanone and cyclopentanone by IR spectroscopy? 2

   (d) The position of UV absorption maxima of aniline in aqueous solution are different from those of benzene but are almost identical with those of benzene in a solution of pH = 1. 2

   (e) Between *cis*-stilbene and *trans*-stilbene, which one will absorb at longer wavelength and why? 2

   (f) How do you monitor the completion of the below reaction by IR spectroscopy? 2



   (g) Draw ^1H NMR signals of CH_3CH_2OH showing the relative chemical shifts, integration and spin-spin coupling pattern. 3

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 4th Semester Examination, 2021

CEMACOR10T-CHEMISTRY (CC10)

ORGANIC CHEMISTRY-IV

Time Allotted: 2 Hours | Full Marks: 40

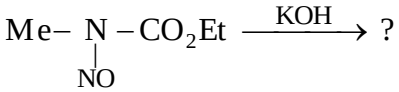
The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

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

Unit-I

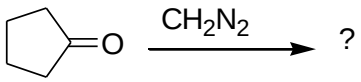
1. (a) Why ammonolysis on the corresponding alkyl bromides (RBr) cannot be used for the preparation of $^tBuNH_2$ and $Me_3CCH_2NH_2$? How would you prepare these amines from carboxylic acids (RCO_2H)? 3

   (b) Give the product with plausible mechanism: 3

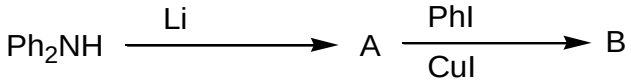


2. (a) Explain why benzene diazonium chloride couples with phenol in alkaline medium but not with anisole under the same reaction conditions. 2

   (b) Give the product(s) of the following reaction with plausible mechanism: 2



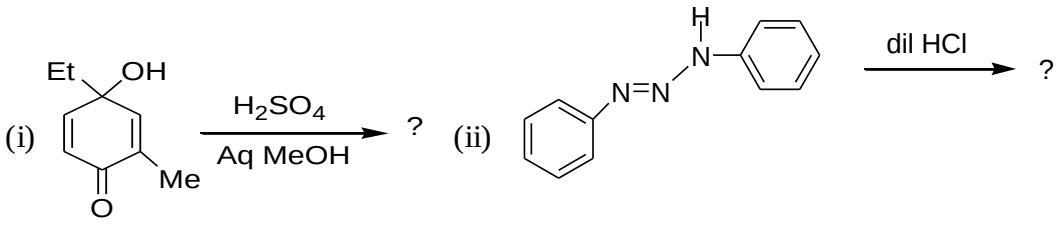
   (c) Identify A and B in the following: 2



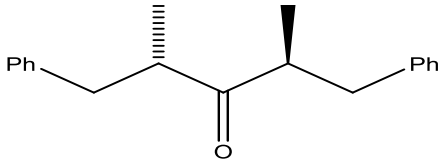
Unit-II

3. (a) In the Arndt-Eistert synthesis two equivalent of diazomethane is recommended. — Explain. 2

   (b) Identify the product(s) in the following with plausible mechanism. 2+2



(c) Derive the product(s) of Baeyer-Villiger rearrangement on the following enantiomerically pure ketone. Suggest mechanism and comment on the stereochemistry of the product(s). 2



4. (a) Carry out the following conversion and suggest plausible mechanism (any ***two***). 2+2

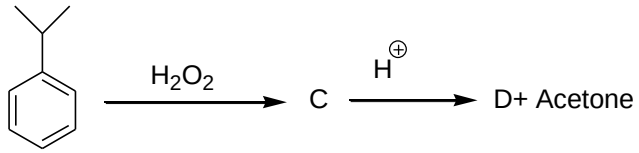
(i) Acetophenone to 2-phenylpropanal

(ii) Phenol to catechol

(iii) *p*-Hydroxyacetophenone to paracetamol.

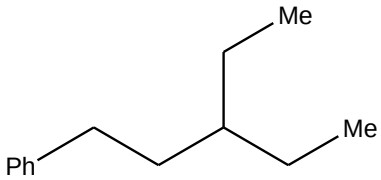
(b) The isomeric pinacols $Ph_2C(OH)C(OH)Me_2$ and PhMeC(OH)C(OH)PhMe undergo acid-catalyzed rearrangement to afford a common product. — Explain. 2

(c) Identify C and D with proper mechanistic explanation. 2

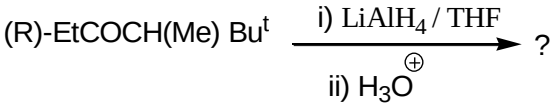


Unit-III

5. (a) Draw the scheme for retro-synthetic analysis of the following hydrocarbon using FGA strategy. Also, depict the synthetic pathway of it. 3

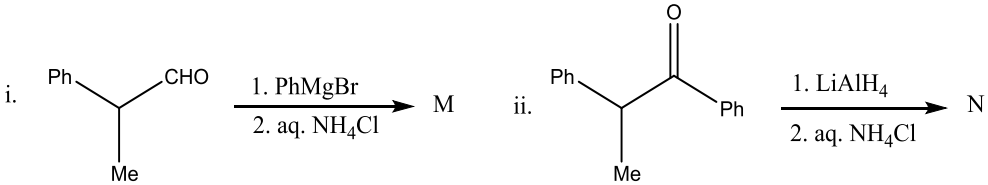


(b) Predict the major product of the following reaction with reason. 3



(c) Explain with suitable examples: Synthon and illogical electrophile. 2+2

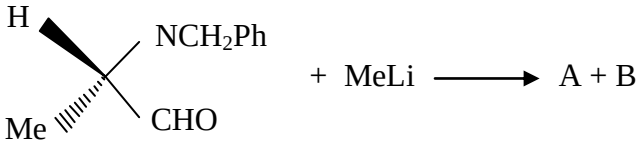
6. (a) Draw the structure of the major products (M and N) in the following reactions. Establish the stereoisomeric relationship between M and N and rationalize the results. 4



(b) What do you mean by high dilution technique for the synthesis of large ring compounds? — Explain. 2

(c) What do you mean by chemo-selective reaction? Give an example. 2

(d) Write the products with proper stereochemistry. Justify your answer. 2



Unit-IV

7. (a) Distinguish the following pair of compounds on the basis of their IR spectra: (any ***two***) 2+2
   (i) Acetone and hexamethyl acetone
   (ii) Salicylic acid and *p*-hydroxy benzoic acid
   (iii) Phenyl acetate and methyl benzoate.

   (b) The UV spectrum of mesityl oxide shows absorption bands at 321 and 230 nm in hexane. Assign them in terms of electronic transition. Depict the changes of this spectrum if the experiment is carried out in 95% ethanol solvent. Justify your answer. 3

   (c) An organic compound of molecular formula $C_6H_{12}O$ shows a peak at 1715 cm^{-1} in its IR spectrum. The ^1H NMR spectrum of the compound displays two singlets at δ 0.9 and 2.2 in the ratio of 3:1. Deduce the structure of the compound and explain the spectral data. 3

   (d) "Two protons are chemically equivalent but magnetically non-equivalent". Justify the statement with an example. 2

   (e) Predict the number(s) of ^1H-NMR peak of chlorocyclopropane and justify. 2

   (f) Esters of *o*-chlorobenzoic acid show two C=O stretching frequencies. — Explain. 2

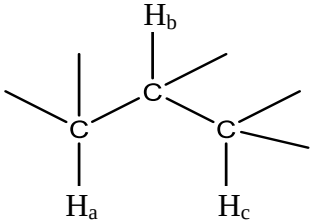
8. (a) Distinguish the following pairs by UV spectroscopy (any ***two***): 3
   (i) *p*-cresol and anisole
   (ii) mesity oxide and $CH_2 = C(Me)CH_2COMe$
   (iii) aniline and cyclohexylamine.

   (b) Predict the organic compound of molecular formula $C_9H_{10}O_2$ from the following spectral data. 3

   IR: 1740 cm^{-1} ; ^1H NMR: δ 1.96 (3H, s), 5.00 (2H, s) and 7.20 (5H, m).

   (c) The stretching absorption maxima for C–H and C–D are approximately 2900 cm^{-1} and 2200 cm^{-1} respectively. Explain why. 2

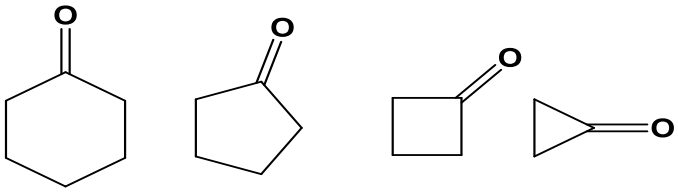
   (d) Draw the splitting pattern for H_b in the ^1H-NMR spectrum of the fragment given below, where 2
   (i) J_{ba} = 12 Hz and J_{bc} = 6 Hz (ii) J_{ba} = 12 Hz and J_{bc} = 12 Hz.



   (e) Define the terms (i) up-field (ii) downfield shifts as used in NMR spectroscopy. 2

(f) The UV absorption maxima of aniline in aqueous solution are different from those of benzene, but the positions of UV absorption maxima of aniline in acidic solution (pH ≃ 1) are almost identical with benzene. — Explain. 2

(g) Arrange the following compounds according to their increasing order of 'C=O' stretching frequency and give reason. 2



I **II** **III** **IV**

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 5th Semester Examination, 2021-22

CEMACOR11T-CHEMISTRY (CC11)

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.

UNIT-I

Answer any *two* questions from the following 12×2 = 24

1. (a) Explain the nature of Jahn-Teller distortion expected for an octahedral complex of Cu(II) ion. 3

   (b) $[NiCl_4]^{2-}$ is paramagnetic, whereas $[PtCl_4]^{2-}$ is diamagnetic, although both Ni(II) and Pt(II) are d^8 ions. — Explain. 3

   (c) With the help of approximate Orgel diagram explain the electronic spectrum of $[V(H_2O)_6]^{3+}$. 3

   (d) Crystal field splitting of the *d*-orbital is more pronounced in the octahedral field than that in the tetrahedral field. — Explain. 3

2. (a) Between the two redox couple, $[Co(OH_2)_6]^{3+}/[Co(OH_2)_6]^{2+}$ and $[Co(NH_3)_6]^{3+}/[Co(NH_3)_6]^{2+}$ which one is more oxidizing and why? 3

   (b) $K_2Ca[Cu(NO_2)_6]$ and $K_2Ba[Cu(NO_2)_6]$ exhibit static Jahn-Teller distortion while $Tl_2Pb[Cu(NO_2)_6]$ shows dynamic Jahn-Teller distortion. — Explain. 3

   (c) Ni(II) is smaller in size in the square planar environment as compared to that in tetrahedral environment, but reverse is the case with Ag(I). — Explain. 3

   (d) Mn^{2+} (aq) is pale in colour whereas aqueous solution of MnO_4^- is intense in colour. — Explain. 3

3. (a) Account for the following order of lattice enthalpies of the octahedral fluorides of 3*d* (M^{2+}) ions: 3

   $$Mn^{2+} < Fe^{2+} < Co^{2+} < Ni^{2+} < Cu^{2+} > Zn^{2+}$$

   (b) Explain why $Ni(CO)_4$ is tetrahedral while $[Ni(CN)_4]^{2-}$ is square planar. 2

   (c) Electronic spectrum of $[CoF_6]^{3-}$ shows two maxima in the visible region. — Explain. 3

   (d) Co^{2+} (d^7, high spin) has a magnetic moment in the range 4.8-5.2 BM in octahedral field, while in tetrahedral environment the value is in the range 4.0-4.4 BM. The reverse type of observation is true for Ni^{2+} ion. — Explain. 2+2

4. (a) Use Jahn-Teller theorem to decide if $[Cr(H_2O)_6]^{3+}$ will have an un-distorted octahedral structure. 3

   (b) State the selection rules for electronic transition in the spectra of metal complexes. 2

   (c) Fe_3O_4 has an inverse spinel structure whereas Mn_3O_4 has a normal spinel structure. — Explain the observation from CFT. 3

   (d) Find out the ground state term for V^{3+} ion. 2

   (e) Calculate the spin-only magnetic moment in Bohr Magneton for $K_3[CuF_6]$. 2

UNIT-II

Answer any *one* question from the following $16\times1 = 16$

5. (a) What is the common oxidation state of lanthanide elements? Why is it so? 1+2

   (b) Give the general electronic configuration of lanthanides and explain the trends in ionic radii of M^{3+} ion of this class. 1+2

   (c) 4*s* orbitals are filled before the 3*d* orbitals but during ionization 4*s* electrons are removed before 3*d* electrons. — Comment. 2

   (d) Discuss how the stability of the oxidation states changes from 3*d* to 4*d* to 5*d* transition metals. 3

   (e) Lanthanides have more or less identical chemical properties while *d*-block elements differ widely in this respect. — Explain. 3

   (f) The electronic absorption spectra of tri-positive lanthanide ions give rise to multiple sharp peaks. — Explain. 2

6. (a) What are the common oxidation states of Cu, Ag and Au ? — Explain. 3

   (b) Why do actinides show larger number of oxidation states compared to lanthanides? 3

   (c) Which one of the following are diamagnetic and which are paramagnetic? 3

   Yb^{2+}, Ce^{4+} and Sm^{3+}

   (d) Cu^{2+} ions are coloured and paramagnetic whereas Zn^{2+} ions are colourless and diamagnetic. — Explain. 3

   (e) Compare the properties of lanthanides and actinides with respect to the following properties: 4

   (i) colour and (ii) absorption spectra.

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 5th Semester supplementary Examination, 2021

CEMACOR12T-CHEMISTRY (CC12)

ORGANIC 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 *four* questions taking *one* from each unit

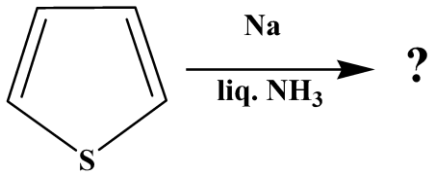
UNIT-I

1. (a) Describe Fischer indole synthesis of 2-methylindole. Write plausible mechanism. How would you demonstrate which nitrogen is lost during cyclisation? 2+1

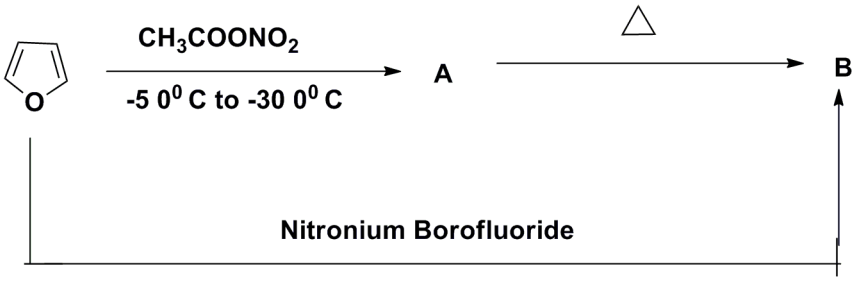
   (b) How could you synthesize anthracene starting from naphthalene using Diels Alder reaction as one of the key steps? 2

   (c) Arrange furan, pyrrole and thiophene in order of increasing aromaticity. 2

   (d) Predict the products in the following reaction with plausible mechanism. 3



2. (a) Identify A and B and explain all the steps. 3



   (b) Unlike pyrrole indole undergoes electrophilic substitution at C-3. Explain. 2

   (c) How can you convert toluene into 1,4,6-trimethyl naphthalene? 3

   (d) Compare the basicity of pyrrole and pyridine. 2

UNIT-II

3. (a) Acetolysis of both cis- and trans-tosylate shown below give the same diacetate. Explain. 3

(b) The cis-1,2-dimethylcyclohexane is less stable than its trans isomer, but cis-1,3-dimethylcyclohexane is more stable than its trans isomer. Draw the most stable conformations of both and explain. 3

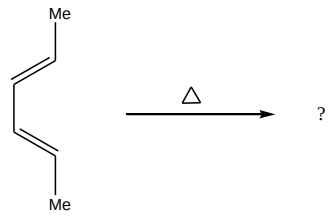
4. (a) Compare the rate of hydrolysis of cis and trans isomer of ethyl 4-t-butylcyclohexane carboxylate. 3

(b) Write down the preferred conformation of cis-4-hydroxyl cyclohexane carboxylic acid. What happens when it is heated? 2+1

UNIT-III

5. (a) Write down the characteristics of pericyclic reaction. 2

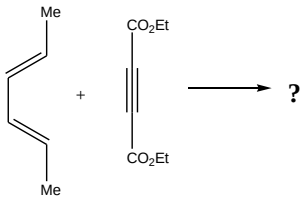
(b) Write down the product of the following reaction. 2



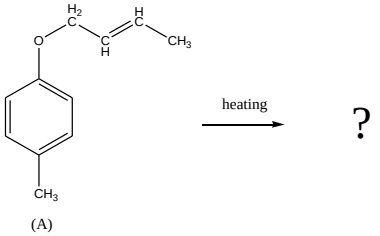
(c) Dimerisation of cyclopentadiene in thermal condition gives preponderantly the *endo* cycloadduct under kinetically controlled conditions. — Explain. 2

6. (a) Define stereoselectivity of 4 pi system under photochemical and thermal condition. 2

(b) Write down the product of the following reaction. 2



(c) What happens when compound A is subjected to heating? 2



(A)

UNIT-IV

7. (a) Write down pyranose structure of D – Glucose. 1

   (b) How can you selectively methylate C_3-OH of D-glucose? 2

   (c) E, F and G are the three aldohexoses. E and F yield D-sorbitol when they are catalytically hydrogenated. E and F yield different osazones when treated with excess phenyl hydrazine. F and G give the same osazone but different alditols. Give structures of E, F and G assuming that F and G are D-aldohexoses. 3

   (d) What happens when D- glucose is subjected to HNO_3 oxidation? 2

8. (a) What are epimers? 1

   (b) Describe mutarotation of glucose. 2

   (c) An aldpentose [P] can be oxidized with dil HNO_3 to an optically active aldaric acid. Kiliani- Fisher synthesis starting with [P] gives two new aldoses [Q] and [R]. Aldose [Q] can be oxidized to an optically inactive aldaric acid, but aldose [R] is oxidized to an optically active aldaric acid. Assuming the D-configuration, give the structures of [P], [Q] and [R] and also justify the assignments. 3

   (d) State with mechanism what happens when D-fructose is heated with Tollen's reagent. 2

UNIT-V

9. (a) Write down the steps for the synthesis of a tripeptide Gly-Ala-Phe in the solid phase with the help of Merrifield resin. 3

   (b) Describe Sanger degradation method for N-terminal amino acid determination of peptide. 3

   (c) Between A-T and G-C, hydrogen bonding in which pair is stronger? Why? 2

   (d) RNA undergoes alkaline hydrolysis at a faster rate than DNA. Explain. 2

10. (a) Describe synthesis of tripeptide Leu-Val -Pro using chemical method. 3

    (b) Outline the Gabriel synthesis of glycine. 3

    (c) Briefly explain the factors responsible for the stabilisation of a DNA duplex. 2

    (d) Differentiate between nucleosides and nucleotides. 2

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 5th Semester Examination, 2021-22

CEMACOR12T-CHEMISTRY (CC12)

Time Allotted: 2 Hours | Full Marks: 40

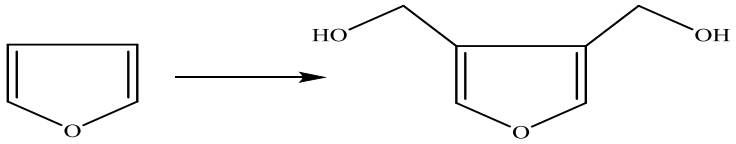
The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

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

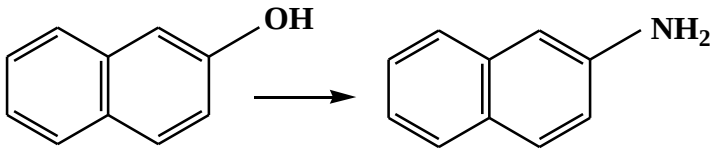
UNIT-I

1. (a) Outline Bogert-Cook Synthesis of Phenanthrene. How can you minimize the formation of the undesired spirocyclic product in this reaction? 2+1

   (b) (i) How can you accomplish the following transformation? 2+2



   (ii) Carry out the following transformation with plausible mechanism.

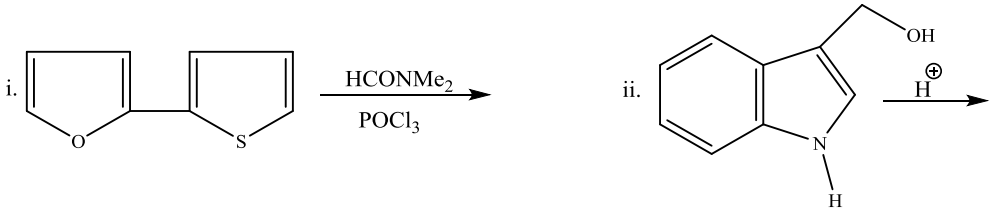


   (c) (i) Compare the basicity of 2-methyl indole and 3-methyl indole. $1\frac{1}{2}+1\frac{1}{2}$

   (ii) State, with mechanism, how can you convert benzaldehyde into 1-methylisoquinoline.

2. (a) What happens when 2-naphthol is treated with ferric chloride? 1

   (b) Predict the product(s) in the following reactions and suggest mechanism in each case. $2\frac{1}{2}+2\frac{1}{2}$

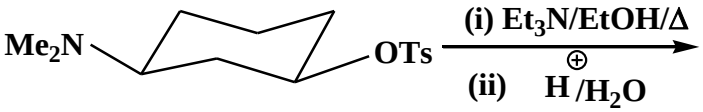


   (c) Furan reacts differently with nitronium fluoroborate and acetyl nitrate (in pyridine) to give 2-nitrofuran. — Explain. 2

   (d) How 2-bromonapthalene is prepared from naphthalene? 2

UNIT-II

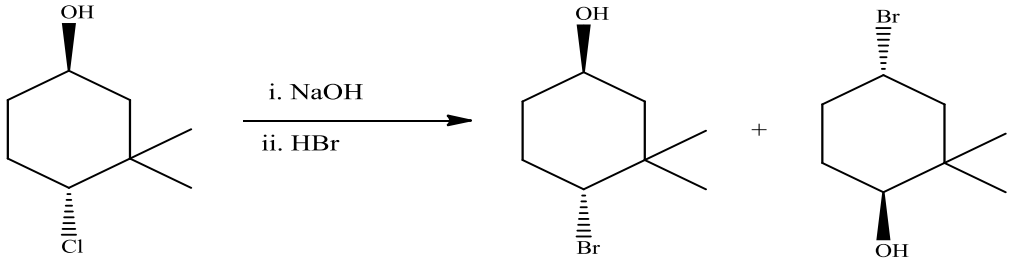
3. (a) Predict the product(s) and give mechanism for the following reaction. $1\frac{1}{2}$



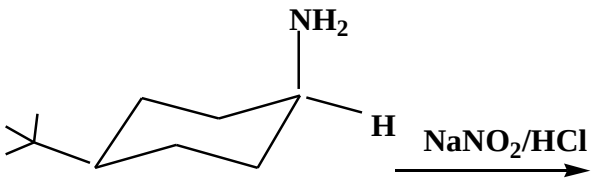
(b) What happens when *cis*-1,3-cyclohexane dicarboxylic acid is heated? Comment on the chirality of the product. 2

(c) Explain the fact that *trans*-4-*tert*-butylcyclohexyl tosylate undergoes bimolecular reaction with the base bromide and thiophenolate, although not with the much stronger base ethoxide. $2\frac{1}{2}$

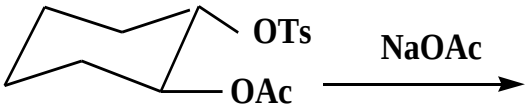
4. (a) Provide a mechanistic rationalisation to explain the stereochemical aspects of the following reaction. 3



(b) Write the product with proper stereochemistry for the following reaction and explain: $1\frac{1}{2}$



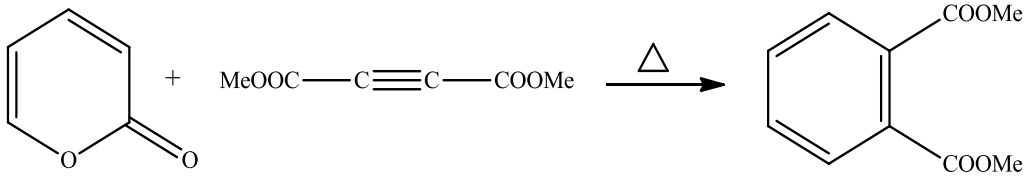
(c) Predict the product of the following reaction with suitable mechanism: $1\frac{1}{2}$



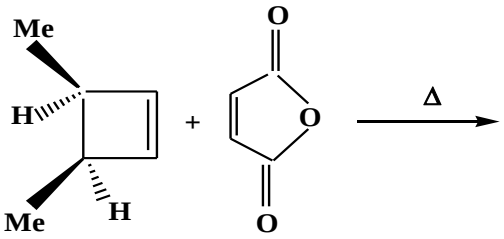
UNIT-III

5. (a) In the thermal ring opening of *trans*-3,4-dimethylcyclobutene, two products can be formed by conrotatory mode, but only one is actually formed. Identify the possible products. Which one is observed and why? 2

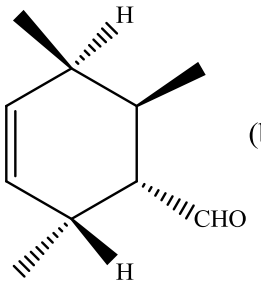
(b) Propose a mechanism for the following reaction clearly indicating the pericyclic steps involved therein. 2



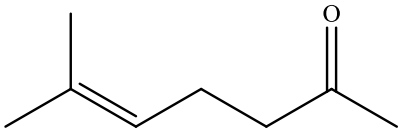
(c) Predict the product with stereochemistry in the following reaction and indicate the reaction pathways: 2



6. (a) How can you synthesise the following compounds as directed? 2

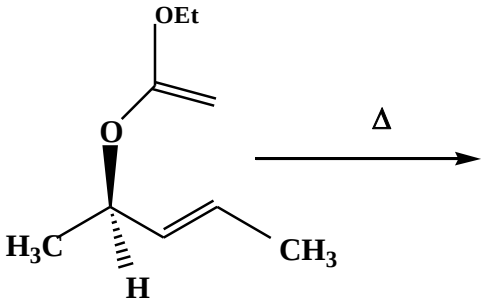
i. 

(by Diels Alder reaction)

ii. 

(by Claisen rearrangement)

(b) Predict the product of the following reaction with explanation: 2



(c) Thermal 1,3-sigmatropic shift of hydrogen is symmetry forbidden but thermal 1,3-sigmatropic shift of an alkyl group may be symmetry allowed. Explain in terms of FMO theory. 2

UNIT-IV

7. (a) *β*-D-Glucopyranose is oxidized at 250 times faster rate than *α*-D-Glucopyranose using Br_2/H_2O. — Explain. 2

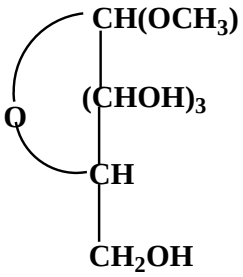
(b) How can you convert D-glucose into: 2

(i) *meso* tartaric acid and (ii) D-glucuronic acid?

(c) D-Glucose and another aldohexose (A) give the same product when treated with sodium amalgam. Find out the structure of (A). To which family between D and L, does (A) belong? 2

(d) How would you distinguish chemically between ribose and 2-deoxyribose? 2

8. (a) How many moles of HIO_4 will be required for the oxidation of one mole of the following compound? Write down the products. 2



(b) Why osazone formation doesn't proceed beyond C-2 of an aldohexose? 2

(c) Clearly represent the most stable conformation of the β-pyranose form of the following sugars and justify. 2

(i) β-D-allopyranose (ii) β-L-glucopyranose

(d) Diisopropylidene derivative of D-glucose can be O-methylated at C-3, but that of D-galactose cannot give the same result. — Explain. 2

UNIT-V

9. (a) Specific rotation of an amino acid is pH-dependent. — Justify. 2

(b) Name one amino acid that produces yellow colour with ninhydrin. Write down the pertinent reaction. 1+2

(c) A tripeptide X on hydrolysis gives two amino acids, Glu (2 equivalent) and Ala (1 equivalent). X does not react with 2,4-dinitrofluorobenzene. Ala is released first when X is incubated with carboxypeptidase. Deduce the structure for X. 3

(d) Define the isoelectric point of an amino acid. How can lysine (pI 9.6) be separated from glycine (pI 5.97) by electrophoresis? 2

10.(a) Explain the role of cellular water in the stabilisation of a DNA duplex. Show the G-C base pairing in DNA. 1+2

(b) In deionised water, isoelectric and isoionic points of an amino acid are identical. — Why? 1

(c) Trace the route of synthesis of Ph-$CH(NH_2)$-CO_2H from phthalimide. 2

(d) Predict the product with mechanism when leucine is heated with acetic anhydride in presence of pyridine. 2

(e) How can you synthesise L-tryptophan using azlactone method? 2

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 6th Semester Examination, 2021

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) 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. (ν_{C-O} =2143 cm^{-1} in free CO). 3

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

$[Cr(CO)_6]$ (ν_{C-O} =2000 cm^{-1}), $[Fe(CO)_6]^{2+}$ (ν_{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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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 6th Semester Examination, 2021

CEMACOR14T-CHEMISTRY (CC14)

PHYSICAL CHEMISTRY-IV

Time Allotted: 2 Hours | Full Marks: 40

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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) 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 25ºC. 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 $^{1}H^{35}Cl$ 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 $^{1}H^{35}Cl$ and $^{2}H^{35}Cl$ 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) $A \xrightarrow{h\nu} A^*$

   (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 ⟶ 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 $1.73\times10^{-2}\,cc^{-1}$ and $1.5\times10^{-4}\,cc^{-1}$ 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 5th Semester Examination, 2021-22

CEMADSE02T-CHEMISTRY (DSE1/2)

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

(Units 1 and 2)

1. (a) What are determinate errors? Name the different types of determinate errors. 2

   (b) The amounts of the component A present in the compound AB are given in percent. 2

   Results of A in %: 48.32, 48.36, 48.23, 48.11 and 48.38.

   Calculate the mean and relative mean deviation.

   (c) Define molar absorptivity. Mention its unit. 2

   (d) What are the basic structural units of a spectrometer? 2

   (e) What special technique is used to determine mercury in water sample below the level of μg/L by AAS? Discuss. 2

   (f) Discuss the basic principle of Job's method of continuous variation. 2

   (g) Name two IR sources and mention their composition. 2

   (h) What are spectral interferences in AAS? Mention few ways to minimize them. 2

2. (a) During standardization of $KMnO_4$ solution by standard oxalic acid, the volume (mL) of $KMnO_4$ required for four titrations were 20.5, 20.8, 20.7 and 20.4. From those data calculate average deviation, relative error (%) and error in ppm of that analysis. 3

   (b) Why ionization suppressor is used in estimation of metal ion by atomic emission spectroscopy? 2

   (c) State one advantage and one disadvantage of atomic absorption spectroscopy over atomic emission spectroscopy. 2

   (d) Discuss the characteristics of normal error curve. 2

   (e) For which purpose graphite furnace atomic absorption spectroscopy is used? What do you mean by atomic absorption analysis by cold vapour technique? 3

   (f) Give one example of isotopic substitution for structure elucidation of compound in analytical chemistry. 2

   (g) The absorption of ultraviolet and visible radiation can be conveniently studied together, but infrared absorption studies are made separately. Explain. 2

GROUP-B

(Units 3 and 4)

3. (a) What basic information can be obtained from the measured weight loss in a TGA curve? 2

   (b) Show graphically (qualitatively) the different steps in thermogravimetric separation of $CaCO_3$ and $MgCO_3$. 2

   (c) State two limitations of TGA. 2

   (d) Show how the boundary potential is a measure of the pH of the external solution in a pH meter. 2

   (e) How can you determine the pKa value of acetic acid by using a conductivity meter? 2

   (f) What is cell constant? How it is determined? 2

4. (a) What are the main factors that affect the thermogram of a compound? 3

   (b) What is derivative thermogravimetry? 2

   (c) Why is it necessary for the glass in the membrane of a pH-sensitive electrode to be appreciably hygroscopic? 2

   (d) Identify the different kinds of potentiometric titrations. 2

   (e) What will be the nature of the conductometric titration curve of oxalic acid by NaOH? How will you determine the equivalence points? 3

GROUP-C

(Unit 5)

5. (a) What do you mean by ion exchange capacity of a cation exchange resin? Explain the factors on which one cation is preferentially adsorbed over another by a cation exchange resin. 2+2

   (b) Why thin layer chromatography is superior to paper chromatography? What do you mean by the term "Chromatogram"? 2+2

   (c) Mention two detectors which are often used in gas chromatography. Why retention time is the basis for gas chromatographic analysis? 2+2

6. (a) What is the basic principle of solvent extraction? 3

   (b) How does chelation help in metal ion extraction? Give example of two chelating agents. 3

   (c) Gel permeation chromatography is a type of size-exclusion chromatography. Justify or criticize the statement. 2

   (d) What is cation exchange resin? Give one example. 2

   (e) What are the mobile and stationary phases in gas-liquid chromatography? 2

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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.

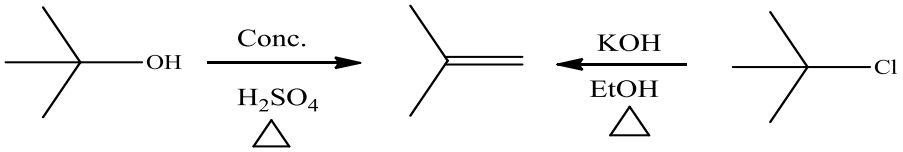
Answer any *three* questions taking one from each Group

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

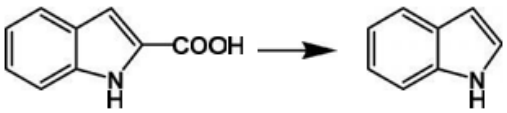
   (b) Write notes on the following topics: $2\frac{1}{2}\times2$

   (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***). $2\frac{1}{2}\times2$

   (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)

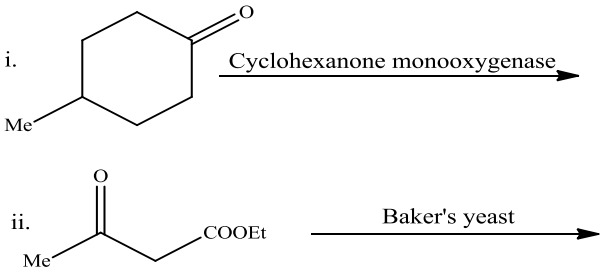
5. (a) Explain the concept of 'Solventless Reaction' in 'Green Chemistry' with at least two suitable examples. 4

   (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: $1\frac{1}{2}\times2$



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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 Part-I Examination, 2021

CHEMISTRY

PAPER: CEMA-II

Time Allotted: 2 Hours | Full Marks: 50

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.

CEMAT-12-PA

Answer any *two* questions taking one from each Unit

Unit-I

1. (a) The number of gas molecules of mass m having speed in the range c and $c + dc$ is given as $dN = Ac^2 e^{-\frac{mc^2}{2k_B T}} dc$. 3

Obtain an expression for 'A'. What is the unit of 'A'?

Given: $\int_0^\infty x^2 e^{-ax^2} dx = \frac{1}{4}\left(\frac{\pi}{a^3}\right)^{1/2}$.

(b) The mass of each molecule of a Maxwellian gas is 5.18×10^{-23} g. Find the average momentum of the gas molecules at 27°C. 2

(c) Calculate the frequency of nitrogen-nitrogen collisions in one cubic centimeter of air at 1 bar and 20°C. Assume that 80% of the molecules are nitrogen molecules. 4

The collision cross section of nitrogen molecule is $4.5\times10^{-19}\ m^2$.

(d) The principle of equipartition of energy predicts the value of heat capacity ratio $\gamma(\gamma = C_p/C_V)$ for $H_2(g)$ more accurately at 110 K compared to that at 10 K. The Boyle temperature of $H_2(g)$ is 110 K. Comment on the result. 2

(e) The mean free path of an ideal gas at 27°C and 1.0 atm is 10^{-5} cm. Suppose the gas is taken to a high altitude where the pressure is only 100 mm of H*g*. Calculate the temperature at which the gas will have the same mean free path at the high altitude. 2

2. (a) Write down Maxwell's expression for the distribution of molecular speeds in three dimensions and derive the expression for the number of molecules with translational kinetic energies greater than ε', assuming $\varepsilon' >>$ kT. 5

(b) Find the dimension of $1/(\sigma^2 n\bar{c})$ where σ, n and $\bar{c}$ are the collision diameter, number of molecules per unit volume and mean speed of molecules respectively. 2

(c) Show schematically the Maxwellian distribution of speed of gas molecules. Indicate on the plot the following. 4

(i) most probable, rms and average speed (relative values)

(ii) fraction of molecules having speed greater than a certain value (c say)

How will be the plot be different for CO_2 and He at the same value of temperature?

(d) Find an expression for the number of molecules striking the unit area of wall of container per unit time. 2

Unit-II

3. (a) The Lennard-Jones potential is expressed as $U(r) = 4\varepsilon\left[\left(\frac{\sigma}{r}\right)^{12} - \left(\frac{\sigma}{r}\right)^{6}\right]$, where r is the internuclear separation. Find an expression for the minimum value of the internuclear separation $(r_{\min})$ in terms of σ and hence show that the minimum value of the potential energy is $U(r_{\min}) = -\varepsilon$. 3

(b) Calculate the change in surface energy when two identical mercury droplets of diameter 2 mm merge to form one drop (assume the process to be isothermal). Surface tension of mercury = 490 dyne cm^{-1}. 3

(c) For the He gas, P_c = 2.24 atm and T_c = 5.2 K. Calculate the radius of the molecule of helium gas. 3

(d) The virial equation in terms of $\bar{V}$ ($\bar{V}$ is molar volume) is given as: 3

$$Z = 1 + \frac{B_{2V}(T)}{\bar{V}} + \frac{B_{3V}(T)}{\bar{V}^2} + ...$$

Where, Z is the compressibility factor. Express the van-der Waals equation for a gas in terms of the virial equation and hence justify that in the limit of every low pressure or very high temperature the behavior of the gas approaches ideality.

4. (a) Draw schematically the *PV vs P* isotherms for N_2 stating the characteristic features at temperatures below, above and at T_B. 3

(b) The second virial coefficient of methane can be approximated by the empirical equation $B(T) = a + be^{-c/T^2}$, where $a = -0.1993$ bar^{-1}, $b = 0.2002$ bar^{-1} and $c = 1131\text{K}^2$. 3

What is the Boyle temperature for methane?

(c) Glycerol flows faster at higher temperatures. — Explain. 3

(d) Find the numerical value of compressibility factor (Z) of a gas that obeys the equation of state $P(V - nb) = nRT$. The pressure and temperature are such that $V/n = 10b$. 3

CEMAT-12-PB

Answer any *two* questions taking one from each Unit

Unit-I

5. (a) For a fixed change in volume, the reversible adiabatic expansion will produce the maximum drop in temperature than the irreversible one. Justify or criticize. 2

(b) The temperature of an ideal gas, with constant heat capacity, is changed from T_1 to T_2 by a constant pressure process and by a constant volume process, then $\Delta S_P = \Delta S_V$ (ΔS refers of the gas). Justify or criticize. 3

(c) Prove that: $C_P - C_V = T\left(\frac{\partial P}{\partial T}\right)_V \left(\frac{\partial V}{\partial T}\right)_P$ and hence find the condition when $C_P = C_V$. Give one example of such a system. 4

(d) Explain whether the heat of an uncatalysed reaction is different from that of a catalysed reaction at a given temperature. When will be the heat of a reaction independent of temperature? 4

6. (a) Justify or criticize any one of the following statements: 2

(i) $\Delta H = q$ for a process in which the initial and final pressures are same but the pressure is not constant throughout.

(ii) Any adiabatic process must be isentropic.

(b) Show that $\left(\frac{\delta\alpha}{\delta p}\right)_T + \left(\frac{\delta\beta}{\delta T}\right)_p = 0$, where α is the coefficient of thermal expansion and β is the compressibility factor. 2

(c) Using a suitable thermodynamic equation of state evaluate the quantity $\left(\frac{\partial U}{\partial V}\right)_T$ for an ideal gas and a van-der Waals gas. Comment on the results. 4

(d) 1 mole of an ideal gas is subject to undergo a reversible cycle involving the following steps: 5

Step 1: Isothermal expansion at temperature T_1 from p_1, $V_1 \rightarrow p_2$, V_2

Step 2: Isochoric change of state from p_2, $T_1 \rightarrow p_3$, T_2 ($p_3 < p_2$)

Step 3: Adiabatic compression from p_3, V_2, $T_2 \rightarrow p_1$, V_1, T_1.

(i) Represent the cycle on a properly labeled *p*-*V* diagram.

(ii) Elucidate the expression for work-done for each step.

(iii) Show that the efficiency of the cycle is $\eta = 1 - \frac{T_1 - T_2}{T_1 \ln(T_1 / T_2)}$.

Unit-II

7. (a) A first order reaction is 20% complete in 15 minutes at 300 K. The same reaction is 39% complete in 10 minutes at 320 K. Calculate the energy of activation (E_A). Will the result (the value of E_A) differ if the reaction be of second order? 4

   (b) A catalyst increases the rate of the forward reaction by 10%. Calculate the change of rate (increase / decrease) of the backward reaction. 2

   (c) Consider the following process 4

   $$A \rightleftharpoons B$$

   $t = 0 \quad a \quad 0$

   $t = t \quad a - x \quad x$

   Find x as a function of t and find also the value of x as $t \to 0$ and $t \to \infty$.

   (d) It is customary, in the study of kinetics of a reaction, to "chill" the reaction by adding an aliquot of the reaction mixture in a *large volume* of *cold water*. Explain why these two conditions are used. 2

8. (a) Write the Arrhenius equation for the variation of rate constant with temperature. Show plots of (i) k *vs* T and (ii) log k *vs* $1/T$. 2

   (b) Draw schematically the energy profile for an exothermic reaction and indicate (i) the activation energy for the forward and the backward reactions, (ii) ΔH of the reaction, (iii) effects of addition of a positive catalyst. 3

   (c) (i) The rate constant (k) of a reaction is given as a function of temperature(T) as follows. 2

   $$\log k = +2.1 - \frac{2.5}{T} + 0.5 \log T$$

   Find the value of the activation energy of the reaction.

   (ii) Find the time for completion for a second order reaction. 2

   (d) Explain the term entropy of activation $(\Delta S^{\neq})$. Comment on the sign of $\Delta S^{\neq}$. 3

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours Part-II Examination, 2021

CHEMISTRY

PAPER: CEMA-III

Time Allotted: 2 Hours | Full Marks: 50

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.

GROUP-A

CEMAT-23-IA

Answer any *one* question from either UNIT-I OR UNIT-II

UNIT-I

1. (a) Account for the anomalous behaviour of the ionisation energies (kJ mol^{-1}) of Group 13 elements as given below: 3

B	Al	Ga	In	Tl
800	577	579	558	589

(b) Discuss the variation in properties of Group 14 elements with reference to 2+2+2
(i) Oxidation state. (ii) Electronegativity (iii) Metallic character

(c) (i) Explain why BCl_3 is mono-meric but $AlCl_3$ is a dimer. 2+2
(ii) $SiCl_4$ is hydrolysed easily whereas CCl_4 is resistant to hydrolysis– Justify.

2. (a) Write the structure of Thiosulfuric and Disulfuric acids and mention the oxidation state of Sulphur atoms in each compound. Discuss the hybridisation of central Sulphur for each case. 4

(b) Why does iodine show evidences of electropositive character? Cite two examples which prove the existence of electropositive iodine. 1+2

(c) What happens when $NaNH_2$ is treated with N_2O ? 2

(d) PCl_3 and NCl_3 hydrolyse in different mode– Explain giving equations. 2

(e) Explain with reasons why SF_6 is known but not SCl_6. 2

UNIT-II

3. (a) Draw the qualitative M.O. energy level diagram of CN^-. Can CN^- act as an ambidentate ligand? Discuss in the light of M.O. theory. 3+2

(b) What do you mean by coordination position isomerism? Give an example to illustrate the definition. 1+2

(c) The fifth water molecule in $CuSO_4 \cdot 5H_2O$ is lost at a higher temperature than the other four molecules. Explain the observation. 2

(d) $[Cr(en)_2Cl_2]Cl$ is found in two forms, one violet and other green. On reaction with oxalate ion, the violet species produces corresponding oxalato derivative, while the green does not. Explain the result and write the IUPAC name of the oxalato derivative. 2+1

4. (a) Discuss the stereo-isomerism of co-ordination complexes having co-ordination number 4 with examples. 3

(b) Draw the qualitative M.D. energy level diagram of CO and calculate the bond order. 3+1

(c) What is the characteristic of semiconductors? Give one example. What is the basic difference between semiconductors and superconductors? 3

(d) State and explain two factors which determine N^- or O^- coordination of NO_2^-. 3

CEMAT 23-IB

Answer any *one* question from either UNIT-I OR UNIT-II

UNIT-I

5. (a) How does structure of boron nitride differ from that of graphite? 2

(b) The product of the reactions of diborane with ammonia depends on conditions of the experiment. – Explain with examples. 2

(c) Hydroxylamine can function both as oxidising and reducing agent. Explain and give appropriate examples. 1+2

(d) What are freons? Explain the effect of photolytic reactions of freons in the upper atmosphere. 1+2

(e) What happens when borazine is treated with HCl? Give equation. 2

6. (a) Give the method for preparation of straight chain and cross-linked silicones. Discuss how the uses of silicones are linked to their properties. 1+3

(b) Complete the following equations: 3

(i) $XeF_2 + SO_3 \rightarrow$ (ii) $XeF_2 + NO \rightarrow$ (iii) $XeF_4 + H_2O \xrightarrow{-80^\circ C} \rightarrow$

(c) Discuss the structure and bonding of ClF_3. 2

(d) What are NO_x? Discuss the role of freons in ozone layer depletion. 1+2

UNIT-II

7. (a) Explain the significance of the principle of solubility product and common ion effect for the precipitation of iron, aluminum and chromium as hydroxides in qualitative analysis. 3

(b) Calculate the cell potential (E_{cell}) for the cell containing 0.1 (M) Ag^+ and 4.0 (M) Cu^{2+} at 25°C. ($E^0_{Cu^{2+}/Cu} = 0.34V$; $E^0_{Ag^+/Ag} = 0.80V$). 3

(c) What is Ellingham diagram? How can the thermodynamics of metallurgical processes be predicted from Ellingham diagram? 3

(d) $Mn^{2+}(aq.)$ is oxidised to MnO_4^- by sodium bismuthate in dil. HNO_3 medium. Balance the reaction by ion-electron method. 3

8. (a) Distinguish between disproportionation and comproportionation reactions. Explain why Cu (I) is not stable in aqueous solution. 2+1

$[E^0_{Cu^{2+}/Cu^+} = +0.15V,\ E^0_{Cu^{2+}/Cu} = +0.34V]$.

(b) Calculate the S^{2-} ion concentration in a 0.25 (M) HCl solution saturated with H_2S at 25°C from the following data: 3+1

(i) Concentration of the saturated solution of H_2S at 25°C is 0.1(M)

(ii) The primary and secondary dissociation constants of H_2S are 9.1×10^{-8} and 1.2×10^{-15} respectively.

Hence, calculate the maximum concentration of Cd^{2+} which will remain in solution after precipitation as CdS under these conditions.

$[K_{sp}(cds) = 5.5\times10^{-25} g\,ion^2/L^2]$.

(c) $E^0_{MnO_4^-/Mn^{2+}} = 1.51V$ and $E^0_{Cr_2O_7^{2-}/2Cr^{3+}} = 1.33V$. Calculate the pH at which these two couples will have the same reduction potential. 3

(d) The solubility product of ferric hydroxide is 1.1×10^{36} at 25°C. Calculate solubility of ferric hydroxide in g / L at this temperature. 2

GROUP-B

CEMAT-23-OA

Answer any *one* question from either UNIT-I OR UNIT-II

UNIT-I

9. (a) How would you distinguish between the members in the following pairs of compound? 2×3

(i) N,N,2,6-tetramethylaniline and N,N,3,5-tetramethylaniline by UV spectroscopy.

(ii) Di-*tert*-butylketone and diethylketone by ^{1}H-NMR spectroscopy.

(iii) Acetylacetone and acetone by IR spectroscopy.

(b) An organic compound ($C_{10}H_{12}O_2$) has the following spectral data: 4

IR (cm^{-1}): 3050, 2950, 1730.

^{1}H-NMR (in ppm): δ 1.30(6H, d); 5.20(1H, m); 7.20(3H, m); 8.00 (2H, m).

Deduce the structure of the compound with the justification of the spectral data.

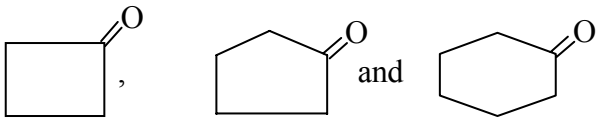
(c) Explain why acetic anhydride shows two carbonyl stretching frequencies in IR spectroscopy? $1\frac{1}{2}$

(d) In ^{1}H-NMR spectroscopy, a particular proton appears at 402 Hz downfield from TMS in a 180 MHz instrument. Calculate its δ-value. $1\frac{1}{2}$

10.(a) Which of the following nuclei are NMR active– Justify. 3

$^{2}D_{1}$ $^{14}N_{7}$ $^{12}C_{6}$ $^{31}P_{15}$ $^{16}O_{8}$ $^{19}F_{9}$

(b) Arrange the following cyclic ketones in increasing order of their carbonyl stretching frequency. Give reason for your answer. 2



(c) An organic compound with molecular formula C_3H_5OCl evolves CO_2 when added to aqueous $NaHCO_3$ solution. Its IR absorption shows a band at 1795 cm^{-1}. It gives a triplet and a quartet signals in its ^{1}H-NMR spectrum. Identify the compound. 3

(d) What in metastable peak in mass spectra? Explain with a suitable example. 2

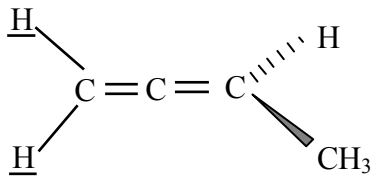
(e) Explain the following: $1\frac{1}{2}+1\frac{1}{2}$

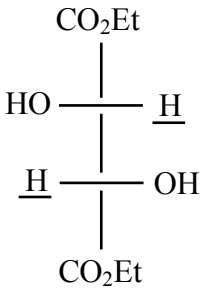
(i) C = C stretching frequency of cyclobutene appears at 1566 cm^{-1}, but that of 1-methylcyclobutene at 1641 cm^{-1}.

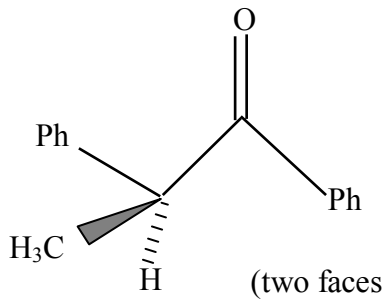
(ii) UV spectra of aniline and phenol are pH-dependent.

UNIT-II

11.(a) Find out the topic relationship between the underlined H atoms and the mentioned faces in the following: 1×3

(i) 

(ii) 

(iii) 

(two faces of carbonyl)

Describe the process by which the relationships are determined.

(b) Explain what happens when ethyl acetoacetate is separately treated as follows: 3

(i) Treated with CH_3COCl and Mg;

(ii) First sodium salt of ethyl acetoacetate is formed and then treated with acetyl chloride.

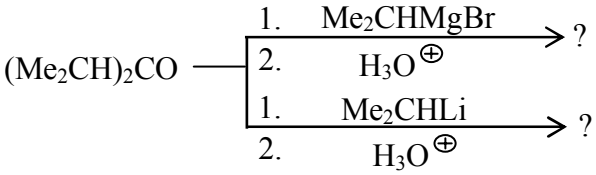
(c) Carry out the following transformations (any ***two***): 2×2

(i) Phenol to coumarin,

(ii) Hydroquinone to 1, 2, 4-trihydroxybenzene,

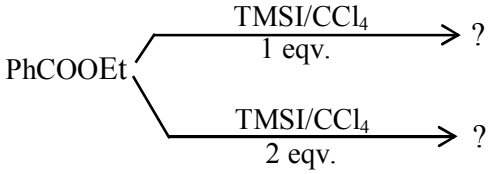
(iii) Phenol to *m*-nitrophenol.

(d) Complete the following reactions and justify the formation of product in each case. 3

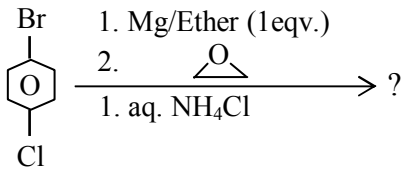


12.(a) Explain the formation of the products in the following reactions. 2×2

(i)

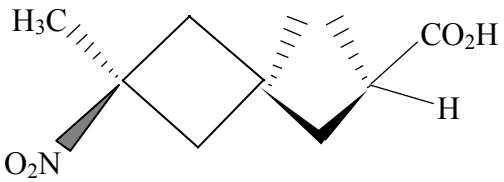


(ii)

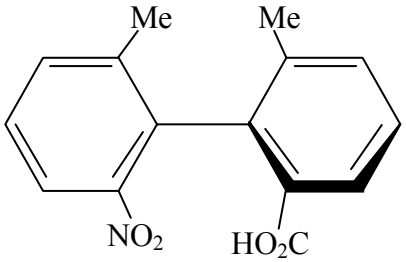


(b) Assign R/S-configuration of the following compounds (any ***two***): $1\frac{1}{2}\times2$

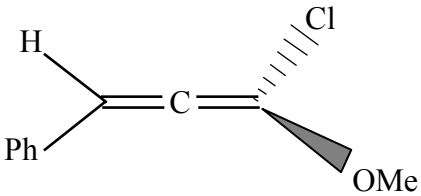
(i)



(ii)



(iii)



Mention the relative priorities of different groups in each case.

(c) Fries rearrangement may be either inter- or intramolecular in nature. Give evidence in favour of the fact. 3

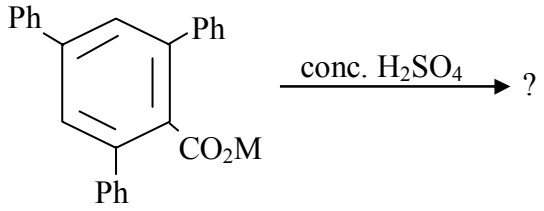
(d) A given sample of optically active 2-butanol shows the specific rotation of –6.76°. If pure (+)-2-butanol has the specific rotation of +13.52°, what is the molar ratio of two enantiomers in the given sample? 3

CEMAT-23-OB

Answer any *one* question from either UNIT-I OR UNIT-II

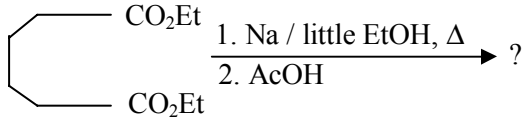
UNIT-I

13.(a) Complete the following reactions giving mechanism (any ***three***): 3×3

(i) 

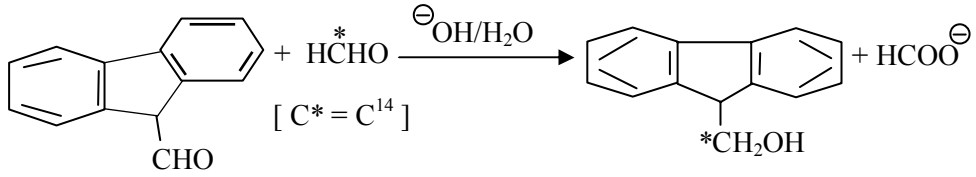
(ii) $RCHO + Al(OEt)_3 \longrightarrow ?$

(iii) $CH_3CHO + HCHO\ (excess) \xrightarrow{Ca(OH)_2} ?$

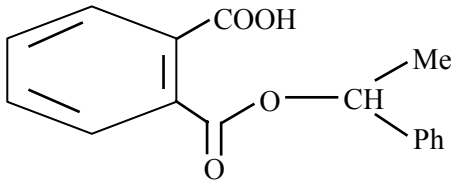
(iv) 

(b) Both *p*-dimethylaminobezaldehyde and *p*-nitrobenzaldehyde fail to undergo benzoin condensation but the mixture of these two undergoes the same condensation. Give the product with the explanation of its formation. 2

(c) Write down the mechanism of the following reaction. 1



14.(a) Alkaline hydrolysis of the optically active half ester given below, forms the racemic alcohol Ph(Me)CHOH. Explain with mechanism. 2



(b) How do you convert $PhCOCH_3$ to mandelic acid? Show the steps giving reagents and reaction conditions. 2

(c) Show the steps for the conversion of PhCHO to PhCDO. 2

(d) Arrange the following compounds in decreasing order of their rates of hydrolysis in alkaline medium and justify your answer. 2

(i) CH_3COCl (ii) CH_3CONH_2 (iii) $CH_3COOC_2H_5$

(e) In the Perkin reaction of PhCHO with Ac_2O and NaOAc, little styrene is obtained. — Explain. 2

(f) What happens when racemic lactic acid is heated? 2

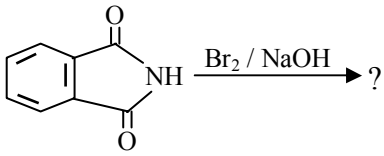
UNIT-II

15.(a) State the action of $NaNO_2$ / HCl on: 3

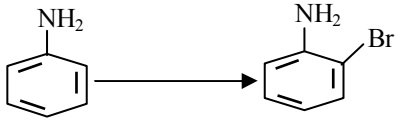
(i) N-methylaniline (ii) N, N-dimethylaniline and (iii) Benzylamine

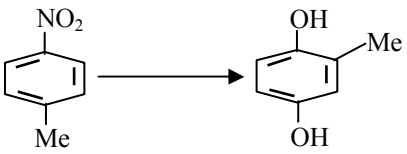
(b) How do you chemically distinguish between C_2H_5CN and C_2H_5NC? 2

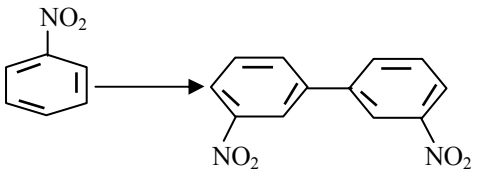
(c) Predict the products with plausible mechanism in the following reactions: 3

(i)  (ii) $Et_2NH \xrightarrow[\Delta]{HCHO,\ HCOOH} ?$

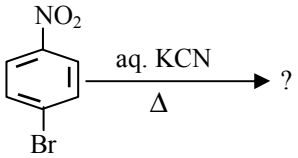
(d) Cary out the following transformations (any ***two***): 2×2

(i) 

(ii) 

(iii) 

16.(a) Give the product (s) formed in the following reactions giving plausible mechanisms. 2×2

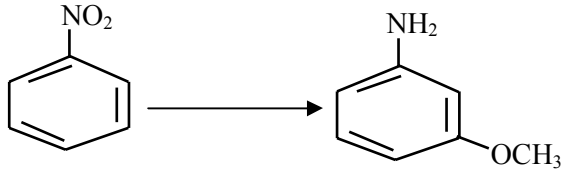
(i)  (ii) $Ph–NH–N=N–Ph \xrightarrow[40°C]{H_3O^+} ?$

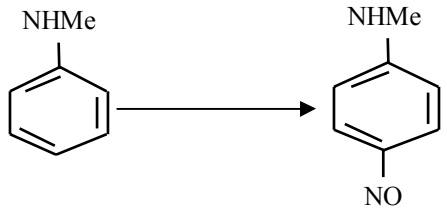
(b) Give an example of each of the following: 1+1

(i) Diazomethane acts as a 1, 3-diploar reagent.

(ii) Diazomethane acts as a base.

(c) Carry out the following conversions. 2×2

(i) 

(ii) 

(d) Predict the product in the following reaction. Give the probable mechanism. 2

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours Part-II Examination, 2021

CHEMISTRY

PAPER: CEMA-IV

Time Allotted: 2 Hours | Full Marks: 50

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.

CEMAT-24-PA

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

Unit-I

1. (a) $\psi = \psi_1 + \sqrt{3}\psi_2$, where ψ_1 and ψ_2 are normalized and mutually orthogonal functions. Normalize ψ. 3

   (b) The stopping potential for photo electrons emitted from a surface irradiated with light of wavelength 3000 Å is 1.91 V. When the incident wavelength is changed the potential is found to be 0.9 V. What is the new wavelength? 4

   (c) If $\hat{A} = \frac{d^2}{dx^2}$ and $\hat{B} = x$. Find out whether (i) $\hat{A}$, $\hat{B}$ commute (ii) $(e^x + \sin x)$ is an eigen function of $(\hat{A} + \hat{B})$. 4

   (d) Show that adding a constant 'c' to the potential energy leaves the stationary state wave functions unchanged and simply adds 'c' to the energy eigenvalues. 2

2. (a) Justify or criticize the following statements: 2+2

   (i) The state function ψ must be a real function.

   (ii) The term *state* and *energy level* are synonymous in quantum mechanics.

   (b) Show that product of two linear operators is a linear operator. 2

   (c) Without evaluating any integral, justify the following: 2+2

   (i) For n = 2 state, the probabilities of finding the particle in the *left half* and the *right half* of a one dimensional box are same.

   (ii) The relation of average values <A + B> = <A> + <B> holds true.

   (d) Show that if f is an eigenfunction of A with eigenvalue a then f will have the eigenvalue a^2 for operator A^2. What property of A you have assumed in your answer? 3

Unit-II

3. (a) State the difference between fluorescence and phosphorescence phenomenon with respect to the following: 4

(i) states involved in the process (ii) nature of transition (iii) position and intensity of spectra.

(b) For the photochemical reaction $A_2 \xrightarrow{h\nu} 2A$, the mechanism is as follows: 4

$$A_2 \xrightarrow{h\nu} A_2^*$$
$$A_2 \xrightarrow{k_2} 2A$$
$$A_2^* + A_2 \xrightarrow{k_3} 2A_2$$

Show that at low concentration of A_2, $\phi = 2$.

(c) Calculate the energy of 1 photon of light of wavelength 2450 Å. Will it be able to dissociate a bond in a diatomic molecule of energy 95 kcal/mol? 4

4. (a) A solution of substance A is irradiated with a light of λ = 3000 Å. The O.D. of solution is 0.398. If intensity of incident radiation is 1.5×10^{17} quanta s^{-1}, calculate the rate of formation of B in the reaction $2A \xrightarrow{h\nu} B + C$. Given: $\Phi = 0.48$. 4

(b) Find out the probability density of finding a 2*s*-electron of H atom (i) at the nucleus (ii) $r = 2a_0$ (iii) at $r = \infty$. Given $\psi_{2s} = \frac{1}{4\sqrt{2\pi}} a_0^{-3/2}\left(2 - \frac{r}{a_0}\right)e^{-r/a_0}$. Hence draw the probability density vs. *r* plot for a 2*s* orbital. 3+2

(c) Show that at low concentration of absorbent, the intensity of absorbed radiation is directly proportional to concentration. 3

CEMAT-24-PB

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

Unit-I

5. (a) How will the advancement of reaction (ξ) change for $N_2O_4(g) \leftrightharpoons 2NO_2(g)$ when (i) 5 mol of Ar introduced keeping mixture at constant P (ii) 5 mol of Ar introduced keeping mixture at constant V? 4

(b) Starting from $H = U + PV$, derive the expression 4

$$\left(\frac{\partial H}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V + V\left(\frac{\partial P}{\partial V}\right)_T.$$

(c) Calculate the change in free energy when 2 mol of H_2, 3 mol of O_2 and 5 mol of N_2 are mixed at 1 atm, 300 K. Gases behave ideally. Also calculate ΔG when the pressure of the mixture is increased to 5 atm. Calculate ΔS_{mix} and ΔH_{mix}. 3

(d) What is the dimension of fugacity coefficient (ϕ)? Will the fugacity coefficient be = +ve, –ve or zero for a real gas having intermolecular repulsive interactions? 2

6. (a) For the reaction: $2A + B \leftrightharpoons A_2B$, $\Delta G^0 = -1200$ cal mol^{-1} at 500 K. What total pressure is necessary to convert 60% of A into A_2B, where A and B are taken in the mole ratio 1:2? 4

(b) Show that (i) $\left(\frac{\partial \mu_i}{\partial T}\right)_{P,n_{j\neq i}} = -\bar{S}_i$, (ii) $S = -\left(\frac{\partial A}{\partial T}\right)_{V,n}$ 2+2

(c) For a reaction represented by $SO_2(g) + ½O_2(g) \leftrightarrows SO_3(g)$, $K_p = 1.7\times10^{12}$ at 300 K. Calculate K_p for $2SO_3(g) \leftrightarrows 2SO_2(g) + O_2(g)$. 2

(d) "Decrease in Helmoltz free energy is a measure of reversible isothermal work done by system." — Explain. 3

Unit-II

7. (a) In a 0.10 M solution of sodium acetate, calculate K_h, the degree of hydrolysis, and the pH at 298 K. [At 298 K, $K_w = 1.0\times10^{-14}$, $K_a = 1.8\times10^{-5}$]. 3

(b) Construct an electrochemical cell for the reaction Ag (s) + ½ Br_2 (l)⇌AgBr (s). 2

(c) Justify / Criticize (i) NH_2^- in liquid ammonia has abnormally high transport number (ii) In a conductometric titration concentration of the titrant is higher than the solution to be titrated. 4

(d) 10 mL 0.1 N acetic acid solution is titrated with 0.1 N NaOH solution. Calculate the pH (i) initially (ii) at the half equivalence point (iii) at the equivalence point. Given K_a of acetic acid = 1.8×10^{-5}. 3

8. (a) Emf of a reversible cell is E at a temperature T. If E is not a function of temperature, find ΔS, ΔG and ΔH in terms of E. 3

(b) If E^0 for $F_2 + 2e^- = 2F^-$ is 2.8 V, then what will be the E^0 for ½ $F_2 + e^- = F^-$? Justify your answer. 2

(c) In a moving boundary experiment with 0.01N HCl, the boundary moved through a distance of 13.9 cm in a tube of diameter 1 cm on passing 11 mA current for 20 min. Find the transport number and mobility of H^+ ions. Given specific conductance of the solution is 10^{-2} ohm^{-1} cm^{-1}. 3

(d) The activity solubility product of $CaCO_3$ is 4.8×10^{-9}. Find out the solubility of $CaCO_3$ in presence of a solution containing NaCl, and $MgCl_2$ each having 0.1 (M) concentration in solution. 4

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours Part-III Examination, 2021

CHEMISTRY

PAPER: CEMA-V

Time Allotted: 2 Hours | Full Marks: 50

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.

CEMAT-35 -IA

Answer any *one* question from the following 12×1 = 12

1. (a) Of the two isomers of $[Pt(NH_3)_2Cl_2]$, one isomer 'A' reacts with thiourea (tu) to produce $[Pt(tu)_4]^{2+}$, whereas the other isomer 'B' produces $[Pt(NH_3)_2(tu)_2]^{2+}$. Predict the isomers 'A' and 'B'. Justify your answer. 2+1

   (b) Calculate CFSE of $Mn(H_2O)_6^{2+}$, $Fe(H_2O)_6^{2+}$, $Co(H_2O)_6^{2+}$ and $Cu(H_2O)_6^{2+}$ and predict most stable complex ion. 2

   (c) Explain the nature of Jahn-Teller distortion expected for an octahedral complex of Cu(II) ion. 2

   (d) Observed magnetic moment value of Co(II) complexes in octahedral field is higher than spin only moment. Explain. 3

   (e) $[NiCl_4]^{2-}$ is paramagnetic, whereas $[PtCl_4]^{2-}$ is diamagnetic although both Ni(II) and Pt(II) are d^8 ions. Explain. 2

2. (a) With the help of approximate Orgel diagram explain the electronic spectrum of $[V(H_2O)_6]^{3+}$. 3

   (b) Although Co(III) and Ni(IV) are d^6 systems yet $[NiF_6]^{2-}$ is diamagnetic but $[CoF_6]^{3-}$ is paramagnetic. – Explain. 2

   (c) Rationalise the given order of stability constants of crystal lattice energies of anhydrous chlorides of the metal ions: 3+1

   $Mn^{2+} < Fe^{2+} < Co^{2+} < Ni^{2+} < Cu^{2+} > Zn^{2+}$.

   Why does Cu^{2+} reluctant to synthesize $[Cu(en)_3]^{2+}$ complex?

   $(en = NH_2 - CH_2 - CH_2 - NH_2)$

   (d) The ions Cr^{2+} and Mn^{3+} are isoelectronic yet $[Cr(H_2O)_6]^{2+}$ is highly reducing while $[Mn(H_2O)_6]^{3+}$ is highly oxidizing – How would you reconcile? 3

3. (a) How will you prepare $K_2[Ni(CN)_4]$? On calculating its magnetic moment, explain the structure of the complex. 3

(b) Explain why (any ***one***): 2

(i) Actinides have greater tendency to form complexes than that of lanthanides.

(ii) Nobelium(II) is more stable and non-reducing while Yb^{2+} is a stronger reducing agent.

(c) Although lanthanides usually exhibit +3 oxidation state, Eu^{2+} and Yb^{2+} have special stability. Explain. 3

(d) What is lanthanide contraction and what is its influence on the chemistry of post lanthanide elements? 2+2

4. (a) How would you prepare $KMnO_4$ from pyrolusite? Explain with reason the oxidising property of $KMnO_4$ in acid and alkali medium. 2+2

(b) Oxo cations are common with the actinides, whereas in case of lanthanides these are not common. Explain why? 2

(c) Absorption spectral characteristics of lanthanides in acidified solution are line like while transition metal complexes show broad band. – Explain. 3

(d) What happens when aqueous solution of Na_2S is added to alkaline solution of sodium nitropruside? Draw the structure of reactants and products. Explain the origin of color change. 3

CEMAT-35 -IB

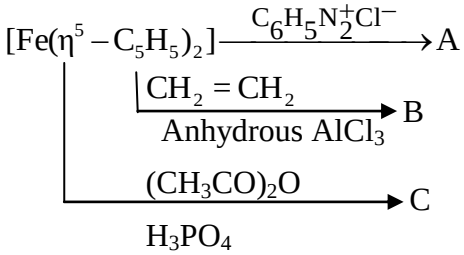
Answer any *one* question from the following 13×1 = 13

5. (a) Define haptocity of non-Werner type complexes. What will be haptocity of ligand in $[Ni(C_5H_5)_2]$? Draw the structure of the complex. 3

(b) Write short notes on Hydrogenation of Olefins (Including mechanism). 4

(c) How is Zeigler Natta Catalyst prepared? 2

(d) Identify the species A, B and C in the following reaction: 3



(e) Using EAN rule determine number of M–M bond(s) in $Mn_2(CO)_{10}$. 1

6. (a) In Zeise's salt the chloride ion trans to ethylene has the larger Pt-Cl distance than the other two Pt-Cl distances — Rationalise. 2+3

Do you expect free rotation of C_2H_4 molecules in Zeise's salt without hampering the stability of the species?

(b) Define 'Hydroformylation reaction'. Explain the role of cobalt organometallics as catalyst in it. 3

(c) How would you prepare Vanadium hexacarbonyl? Does it obey 18-electron rule? Give reasons for your answer. 2+1

(d) What are fluxional molecules? Cite one example. 1+1

7. (a) What is Zeimmermann-Reinhardt reagent? Explain the function of its constituents in permanganometric estimation of Fe^{3+} ion. $1\frac{1}{2}+1\frac{1}{2}$

   (b) What are co-precipitation and post-precipitation? How is post-precipitation avoided during gravimetric analysis? 1+1+1

   (c) Write the principle of estimation of Cu^{2+} ion iodometrically. How is thiosulphate solution standardized? What is the function of thiocyanate in this titration? 2+1+1

   (d) What are masking and demasking agents? Give examples. 3

8. (a) Give the principle of argentometric estimation of chloride using adsorption indicator. 3

   (b) Find the oxidimetric equivalent weight of $KBrO_3$. 2

   (c) Why in iodometric titration addition of starch indicator is suggested near the end point of titration? 2

   (d) Briefly describe the dissolution process of chalcopyrites and hence write the principle for estimation of copper in the solution. 3+3

CEMAT-35 –AA

Answer any *one* question from the following 13×1 = 13

9. (a) What is Na^+ ion pump? Explain the mechanism of this. 3

   (b) Give example of a toxic metal and discuss its toxic effects on human body. 3

   (c) What are the biological functions of (i) Myoglobin and (ii) Ferridoxin? 3

   (d) What are photosystems -I and -II? Explain the role of metal ion involved in them. 4

10. (a) Write a brief note on biological nitrogen fixation. 3

    (b) Name an Au complex used as drug and state its therapeutic applications. 1+2

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

    (d) Mention two diseases caused by metal deficiency in the human body. Explain the role of the metals in the metabolic process. 2+2

11. (a) Briefly discuss the viscosity method for determination of molecular weight of polymers. 3

    (b) Mention two differences between: 2+2

    (i) Step growth polymerization and chain polymerization.

    (ii) Carbon nanotubes and graphene.

    (c) Find the value of *n* assuming the validity of the 18 electron rule in the following compounds: 2+2

    (i) $Ru_3(CO)_n$ (ii) $Fe_4(\eta^5-Cp)(\eta^1-Cp)(CO)_n$

    (d) Give an example of a metal surface catalysis reaction. 2

12. (a) Explain the structure of fullerene-C_{60}. Reduced fullerene has many practical applications. — Comment. 3

(b) Zeolites play an important role in heterogeneous catalysis. Explain with an example. 4

(c) A sample of polymer contains 5, 25, 40 and 30 per cent molecules of the polymer with molecular weights 10,000; 12,000; 13,000 and 15,000. Determine the weight average and number average molecular weights of the polymer sample. 3

(d) Describe in detail any chemical method for the synthesis of Au nanoparticles. Explain the role of the different chemicals used in the synthetic process. 3

CEMAT-35 -AB

Answer any *one* question from the following 12×1 = 12

13.(a) What are nucleosides and nucleotides? Show the structure of nucleotide containing the base which occurs only in RNA, but not in DNA. 4

(b) Explain the differences between secondary and tertiary structures of protein. What types of bonding interaction are present in each case? 4

(c) What do you mean by protein renaturation? 2

(d) Name one amino acid residue which is rarely found in alpha helix. Give reason. 2

14.(a) Describe the salient features of Watson and Cricks double helical model of DNA. 3

(b) What forces stabilize α helices? Which amino acids have highest propensity to form α helices? 2+2

(c) How are enzymes classified? Name the different classes of enzymes. 3

(d) A sample of DNA contains 30% cytosine **(C)** as a base. Calculate the % of other bases present in the sample. 2

15.(a) What is meant by electrophoresis? How would you determine the molecular weight of a protein by gel electrophoresis? 5

(b) What is turnover number of an enzyme? 2

(c) Derive the *Michaelis-Menten equation* for an enzyme-catalyzed reaction and from therein deduce the Lineweaver-Burk form. 5

16.(a) Discuss the principle characteristics of competitive inhibition. What is turnover number? 3+2

(b) How do lyophilic colloids differ from lyophobic colloids? Lyophilic sols are more stable than lyophobic sols. Explain. 2+2

(c) Define autocatalysis. What is the nature of a rate equation of such reactions? Explain with an example. 3

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours Part-III Examination, 2021

CHEMISTRY

PAPER: CEMA-VI

Time Allotted: 2 Hours | Full Marks: 50

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.

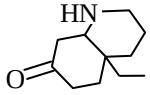
CEMAT-36-OA

Answer any *one* question from either UNIT-I or UNIT-II

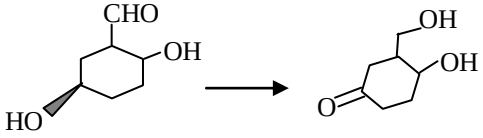
UNIT-I

1. (a) Write two synthetic equivalents of $CH_3 - \overset{\ominus}{C} = O$. 1

(b) Give retrosynthetic analysis of the following molecule – 2

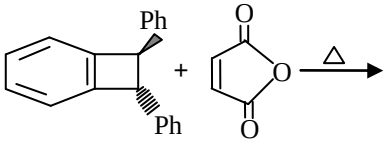


(c) Carry out the following conversion indicating proper reagents. 2

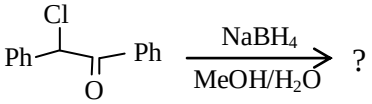


(d) Alkaline solutions of 1-methyl-2-naphthol and 2-methyl-1-naphthol react with benzene diazonium chloride in different manner – Explain. 2

(e) Predict the product of the following reaction indicating FMO interactions. 3



(f) Draw the structure of the major diastereoisomer in the following and justify the diastereoselectivity with appropriate model. 3



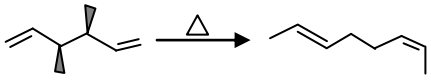
2. (a) What do you mean by illogical electrophile and illogical nucleophile? Give one example of each. 2

(b) Mention two criteria for a good protecting group. Using protection and deprotection techniques outline the following transformations. 2+2

(c) Thermal [1, 5] hydrogen shift is facile but [1, 3] hydrogen shift is not observed. Explain. 2

(d) How will you prepare anthracene from naphthalene? 2

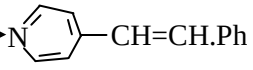
(e) How would you account for the following transformation? 3

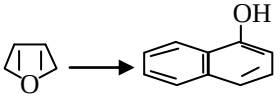


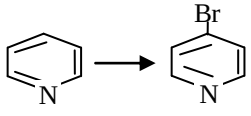
UNIT-II

3. (a) How would you synthesize 2-chloro-4-methylquinolene and 4-chloro-2-methylquinoline separately from the same starting material? Explain with mechanism. 2+2

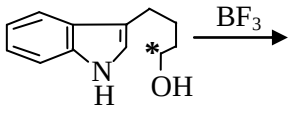
(b) Carry out the following transformations (any ***two***): $2\frac{1}{2}+2\frac{1}{2}$

(i) 4-methylpyridine 

(ii) 

(iii) 

(c) Complete the reaction and explain with mechanism. 2

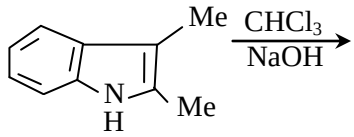


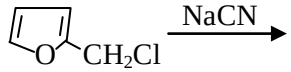
(d) Arrange the following species in order of decreasing delocalization energies. Justify your choice. 2

Pyrrole, Furan, Thiophene, Benzene.

4. (a) Write down the synthesis of Sulphadiazine and mention one important use of this compound. 2+1

(b) Predict with proper justification the product(s) in the following reactions. 4

(i) 

(ii) 

(c) What happens when quinoline and pyridine are treated with Na in liq ammonia separately? Explain with suitable mechanism. 3

(d) Describe Fischer indole synthesis of 2-methylindole. Write plausible mechanism. How would you demonstrate which nitrogen is lost during cyclisation? 2+1

CEMAT-36-OB

Answer any *one* question from either UNIT-I or UNIT-II

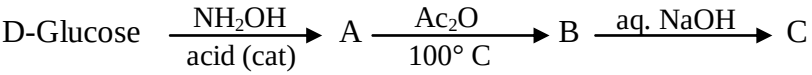
UNIT-I

5. (a) Draw the structure of L-arabinose and explain why it shows abnormal mutarotation. 1+2

(b) What is anomeric effect? Explain the fact that in dry methanol α- and β-D(+) glucose exist in equal amounts. 1+2

(c) Draw the preferred pathway of ring inversion of cyclohexane with appropriate conformations. Which symmetry element is retained along this pathway? Explain. 3

(d) Write the structures for A, B and C in the following transformation. 3



6. (a) Arrange the following dichlorocyclohexanes in order of decreasing amount of (a, a) form present in their conformational equilibrium. Give reasons. 3

trans-1, 4-dichlorocyclohexane, *cis*-1,3-dichlorocyclohexane,
trans-1, 2-dichlorocyclohexane.

(b) Explain the formation of the products when D-glucose is separately allowed to react with acetone/dry HCl and benzaldehyde/dry HCl. 3

(c) β-D-glucose is oxidized to gluconolactone with bromine-water at a much faster rate than α-D-glucose. Explain. 2

(d) Which diastereomer of 4-*tert*-butylcyclohexanol undergoes faster chromic acid oxidation and why? 2

(e) How would you justify the fact that all the methyl pyranosides of α-D-hexose series have the same configuration at C–1 and C–5? 2

UNIT-II

7. (a) Draw the stereoisomers of citral. Device a chemical method for the determination of the configuration of the stereoisomers of citral. 3

(b) Most amino acids form a purple product when heated with ninhydrin. Draw the mechanism for the formation of a coloured product when valine is treated with ninhydrin. 3

(c) Synthesise the tripeptide gly.phe.ala by solid phase peptide synthesis methodology. Explain the choice of protecting groups in this synthesis. 3

(d) How will you prepare phenylalanine by Erlenmeyer Azlactone synthesis? 2

(e) Give the CIP configurational descriptor of L-cysteine. 1

8. (a) What happens when ephedrine and ψ-ephedrine are heated separately with diphenylboronic acid? What structural information do you get from the above reactions? 2

(b) How would you establish by chemical reaction that geraniol and nerol have *trans*-and *cis*-configurations, respectively? 2

(c) Explain with mechanism the role of 2, 4-DNFB for the determination of N-terminal residue of a protein. 2

(d) Show how methionine residue in a polypeptide can be selectively cleaved by cyanogen bromide. 3

(e) What is isoelectric point of an amino acid? Explain why the isoelectric point of glycine is 6.0, while that of lysine is 9.5. 1+2

CEMAT-36-PA

Answer any *one* question from either UNIT-I or UNIT-II

UNIT-I

9. (a) Consider a system following Boltzmann distribution, having two energy levels at energies zero and β^{-1}. If the lower level is non-degenerate and the upper one is doubly-degenerate, then find the probability of occupying a state of energy β^{-1}. 3

[Given: $\beta = \frac{1}{k_b T}$, k_b = Boltzmann constant]

(b) If internal energy of a system of N molecules is U, then show that $U = Nk_bT^2\left(\frac{d\ln f}{dT}\right)$ [Given : f = molecular partition function]. 4

(c) At absolute zero H_3CD has residual entropy as 11.7 JK^{-1} mol^{-1}. Explain. 3

(d) Evaluate Einstein temperature θ_E, for diamond, for which frequency of oscillation of the atoms, ν, is 46.5×10^{12} Hz. 3

10.(a) For a system, which follows Boltzmann distribution, with one state at zero energy and another state at the energy, ε, the populations in the states tend towards equality as $T \to \infty$. Justify. 3

(b) Entropy, S, is expressed as, $S = k_b(N\ln N + \alpha' N + \beta E)$ where N = number of molecules, α' is a number and β is constant at a particular temperature. Find β. 4

(c) If the work function, A, is 3

$$A = -Nk_bT\ln f$$

then show that

$$P = Nk_bT\left(\frac{\partial \ln f}{\partial V}\right)_T$$

where N = number of molecules, f = molecular partition function.

(d) In adiabatic demagnetization during demagnetisation step entropy is supposed to be increased. Justify/criticise. 3

UNIT-II

11.(a) Consider the first line (J = 0) in the rotational spectrum of carbon monoxide as 3.84 cm^{-1}. Find the moment of inertia and the equilibrium inter-nuclear distance. 3

(b) For the rigid diatomic molecule, the infra-red spectral absorption occurs exactly at the classical vibrational frequency. Explain. 3

(c) Calculate the relative population in the J = 1 state with respect to J = 0 state at 300 K considering B = 2 cm^{-1}. Comment on how the relative population changes with increase of J and B value. 3+1

(d) If a' vibrational mode of a molecule is Raman active then it should be infra-red inactive. Justify / criticise. 3

12.(a) In pure rotational Raman spectrum of a diatomic molecule the separation of the first line from the exciting line is 6B cm^{-1}, while that between successive lines is 4B cm^{-1}. Explain. [Given: B = rotational constant] 3

(b) For a diatomic molecule, behaving as anharmonic oscillator, the maximum vibrational quantum number, v_{max}, is given by, $v_{max} = \frac{1}{2\tilde{x}_e} - 1$. 3

($\tilde{x}_e$ is anharmonicity constant).

(c) The spectrum of HCl shows very intense absorption at 2886 cm^{-1}, a weaker one at 5668 cm^{-1}, and a very weak one at 8347 cm^{-1}. Calculate the fundamental frequency, ω_e and the anharmonicity constant, x_e. 4

(d) Explain the Stokes and anti-Stokes lines in Raman spectra according to the classical theory of Raman effect. 3

CEMAT-36-PB

Answer any *one* question from either UNIT-I or UNIT-II

UNIT-I

13.(a) Define primitive unit cell. State the law of rational indices. Find out the Weiss indices and Miller indices for the plane having intercepts $2a$, b, $-2c$ on the respective crystallographic axes, where a, b and c are the primary intercepts on the axes. 1+1+1+1

(b) Using X-ray of wavelength $\lambda = 1.79 \times 10^{-8}$ cm, a metal produces reflection from the (110) plane of B.C.C. unit cells, what is edge length of the cube? 3

(c) Mention the properties of liquid crystal. 2

(d) At 0°C, the molar polarization of a liquid is 32.16 cm^3 mol^{-1} and its density is 1.92 g cm^{-3}. Calculate the relative permittivity of the liquid. 3

[Given: Molar mass of the liquid, M = 55.0 g mol^{-1}]

14.(a) Define 'surface excess'. Derive an equation to show the dependence of surface excess on surface tension of a two component system, stating the assumptions made. 1+4

(b) If the dipole moment of chlorobenzene is 1.57 D then find that for m-dichlorobenzene. 2

(c) The polarizability volume of NH_3 is 2.22×10^{-30} m^3; calculate the induced dipole moment of the molecule by an applied electric field of strength, 15.0 kVm^{-1}. 2

[Given: $\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2J^{-1}m^{-1}$; $1\,D = 3.33564 \times 10^{-30}$ cm].

(d) Molar polarization values of O_2 and CH_4 are independent of temperature while those HCl gas and CH_3Cl gas decrease with increase of temperature. Explain with proper reasons. 3

UNIT-II

15.(a) Derive thermodynamically using chemical potentials a relation between the depression of freezing point of a solvent and the molal concentration of nonvolatile solute dissolved in it pointing out the assumptions and approximations involved if any. 4+2

(b) Liquid carbon dioxide cannot exist at normal atmospheric pressure whatever be the temperature. Justify. 2

(c) The normal boiling temperature of benzene is 353.24 K, and the vapour pressure of liquid benzene is 1.19×10^4 Pa at 20.0°C. If the triple point temperature is 278 K then find the triple point pressure. 4

16.(a) Explain Eutectic point, Eutectic temperature and Eutectic composition with the help of a phase diagram. 3

(b) What is an azeotropic mixture? How would you ascertain that an azeotrope is a mixture, not a compound? 3

(c) The molecular origin of Raoult's law is the effect of solute on the entropy of the solution. Explain qualitatively. 2

(d) A mixture of 100 g water and 80 g of phenol separates into two layers at 60°C. One layer, L_1, consists of 44.9% water by mass; the other L_2, consists of 83.2% water by mass. Calculate the total number of moles in L_1 and L_2. [Given: molar mass of phenol = 94.11 g mol^{-1}] 4

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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WEST BENGAL STATE UNIVERSITY

B.Sc. Programme 5th Semester Examination, 2021-22

CEMGDSE01T-CHEMISTRY (DSE1)

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.

প্রান্তিক সীমার মধ্যস্থ সংখ্যাটি পূর্ণমান নির্দেশ করে।
পরীক্ষার্থীরা নিজের ভাষায় যথা সম্ভব শব্দসীমার মধ্যে উত্তর করিবে।

All symbols are of usual significance.

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

GROUP-A

(Units 1, 2, 3, 4)

1. (a) Define monomer and repeat unit. 2

মনোমার এবং পুনরাবৃত্তি একক সংজ্ঞায়িত করো।

(b) Which of the following polymers lacks the ability to exhibit tacticity? 1

নিম্নলিখিত পলিমারগুলির মধ্যে কোন্‌টিতে tacticity প্রদর্শন ক্ষমতার অভাব রয়েছে ?

(i) Polypropylene (ii) Polystyrene (iii) Polyisobutylene

(c) What is functionality? Give an example of bifunctional monomer. 2

Functionality কী ? Bifunctional মনোমারের একটি উদাহরণ দাও।

(d) Write down the structure of the following polymers. 3

(i) Phenol Formaldehyde Resin

(ii) Styrene Butadiene Rubber (SBR)

(iii) Nylon 6,6

নিম্নলিখিত পলিমারগুলির গঠনাকৃতি লেখো।

(i) ফেনল ফর্মালডিহাইড রেজিন

(ii) স্টাইরিন বিউটাডাইন রাবার (SBR)

(iii) নাইলন 6,6

(e) What is meant by step polymerization? Name two polymers with structure synthesized by step polymerization mechanism. What kind of catalyst is generally used in coordination polymerization? Give one example. 1+2+1+1

সোপান পলিমারিজেশন বলতে কী বোঝো ? গঠন সংকেতসহ সোপান পলিমারিজেশন প্রক্রিয়ায় উৎপন্ন দুটি পলিমারের নাম লেখো। সবর্গীয় বা কোঅর্ডিনেশন পলিমারিজেশনে সাধারণত কী ধরনের অনুঘটক ব্যবহার করা হয় ? একটি উদাহরণ দাও।

(f) Define degree of crystallinity of a polymer. By which instrument we can determine crystalline melting point of a polymer? 3

একটি পলিমারের স্ফটিকতার মাত্রা সংজ্ঞায়িত করো। কোন্ যন্ত্রের মাধ্যমে আমরা পলিমারের স্ফটিক গলনাঙ্ক নির্ধারণ করতে পারি ?

2. (a) What do you mean by homopolymer and copolymer? Give two examples of each along with their structures. 2+2

হোমো-পলিমার ও কো-পলিমার বলতে কী বোঝো ? গঠনাকৃতিসহ প্রতি প্রকারের দুটি করে উদাহরণ দাও।

(b) What do you understand by the degree of polymerization and extent of reaction? 3

পলিমারাইজেশনের মাত্রা এবং বিক্রিয়ার ব্যাপ্তি বলতে কী বোঝো ?

(c) What is ionic chain polymerization? Highlight the role of initiator in chain polymerization mechanism. Give name of initiators used in cationic and anionic chain polymerization process (two in each case). 1+1+2

আয়নীয় শৃঙ্খল পলিমারিজেশন কী ? শৃঙ্খল পলিমারিজেশন প্রক্রিয়ায় প্রারম্ভকারী পদার্থের (initiator) ভূমিকা লেখো। ক্যাটায়নিক ও অ্যানায়নিক শৃঙ্খল পলিমারিজেশনে ব্যবহৃত প্রারম্ভকারী পদার্থের নাম লেখো (প্রত্যেক প্রকারের দুটি করে)।

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

মুক্ত মূলক পলিমারাইজেশনে সাধারণভাবে ব্যবহৃত যে-কোনো দুটি initiator-এর উদাহরণ দাও।

(e) What is the structure of a polymer crystal and how do we characterize it experimentally? 3

পলিমার কেলাসের গঠন কী এবং আমরা কীভাবে এটিকে পরীক্ষামূলকভাবে বৈশিষ্ট্যযুক্ত করব ?

GROUP-B

(Units 5, 6, 7)

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

উদাহরণসহ elastomer এবং ফাইবারের মধ্যে পার্থক্য করো।

(b) A polymer sample contains 200 molecules of molar mass, $M = 1\times10^3$, 300 molecules of molar mass, $M = 1\times10^4$ and 500 molecules of molar mass, $M = 1\times10^5$. Calculate M_n and M_w for the sample. 3

একটি পলিমার নমুনায় $M = 1\times10^3$ আণবিক ভরের ২০০টি, $M = 1\times10^4$ আণবিক ভরের ৩০০টি এবং $M = 1\times10^5$ আণবিক ভরের ৫০০টি অণু আছে। নমুনাটির M_n ও M_w গণনা করো।

(c) What is intrinsic viscosity? 2

অন্তর্নিহিত সান্দ্রতা কী ?

(d) Discuss how to determine number average molecular weight (M_n) of a polymer by osmotic pressure measurement. 4

অভিস্রবণ চাপ পরিমাপ দ্বারা পলিমারের সংখ্যা গড় আণবিক ভর (M_n) নির্ণয়ের পদ্ধতি বর্ণনা করো।

4. (a) What is glass transition temperature (T_g) of a polymer? T_g of perspex, polystyrene and nylon-66 are 105 °C, 100 °C and 45 °C respectively. What is likely to happen to a sample of each of them, if it were hit by a hammer at (i) 0 °C (ii) 20 °C (iii) 80 °C (iv) 120 °C? Give reasons. 1+3

পলিমারের গ্লাস ট্রানজিশন তাপমাত্রা (T_g) বলতে কী বোঝো ? পার্সপেক্স, পলিস্টাইরিন এবং নাইলন 66-এর T_g যথাক্রমে 105 °C, 100 °C ও 45 °C। যদি প্রতিটি নমুনা-কে (i) 0 °C (ii) 20 °C (iii) 80 °C এবং (iv) 120 °C তাপমাত্রায় একটি হাতুড়ি দ্বারা আঘাত করা হয় তবে কি ঘটতে পারে তা কারণসহ লেখো।

(b) What do you mean by Molecular Weight Distribution (MWD)? Point M_n, M_w and M_v in the MWD curve. What is the value of polydispersity index for a monodispersed polymer sample? 2+1+1

আণবিক ওজন বিস্তার (MWD) বলতে কী বোঝো ? আণবিক ওজন বিস্তার লেখচিত্রে M_n, M_w ও M_v বিন্দু চিহ্নিত করো। একটি অতি সংকীর্ণ (monodispersed) পলিমার নমুনার বিস্তৃতি সূচক-এর মান কত ?

(c) What are thermoplastic and thermosetting plastic? 2

থার্মোপ্লাস্টিক এবং থার্মোসেটিং প্লাস্টিক কী ?

(d) Degree of polymerization of PMMA (Polymethylmethacrylate) is 1000. Calculate the molecular weight of PMMA polymer. 2

PMMA (পলিমিথাইলমিথাক্রিলেট)-এর পলিমারিজেশন মাত্রা 1000। PMMA পলিমারের আণবিক ভর নির্ণয় করো।

GROUP-C

(Units 8 and 9)

5. (a) Briefly describe the preparation, structure, properties and few important applications of any two of the following polymers. 4+4
(i) Polypropylene (PP) (ii) LDPE (low density polyethylene) (iii) Phenol formaldehyde rasin (iv) Nylon 6,6

নিম্নলিখিত পলিমারগুলির মধ্যে যে-কোনো দুটি পলিমারের উৎপাদন, গঠন, বৈশিষ্ট্য এবং ব্যবহার সংক্ষেপে বর্ণনা করো।
(i) পলিপ্রোপিলিন (PP) (ii) LDPE (নিম্ন ঘনত্ব বিশিষ্ট পলিইথিলিন)
(iii) ফেনল ফর্মালডিহাইড রেজিন (iv) নাইলন-6,6

(b) Write the structure of polyaniline and polythiophene 2

Polyaniline এবং Polythiophene-এর গঠন কাঠামো লেখো

(c) How can you prepare polyurethanes commercially? 2

কিভাবে বাণিজ্যিকভাবে পলিইউরেথেন প্রস্তুত করবে ?

6. (a) Using Flory-Huggins theory for polymer solution deduce an expression for the entropy of mixing. 4

পলিমার দ্রবণের জন্য ফ্লোরি-হাগিন্স তত্ত্ব ব্যবহার করে মিশ্রণের এনট্রপির একটি সমীকরণ উপপাদন করো।

(b) How can you prepare phenol-formaldehyde resins? Write down all necessary chemical reactions. 3

কিভাবে ফেনল-ফর্মালডিহাইড রেজিন প্রস্তুত করবে ? সকল প্রয়োজনীয় রাসায়নিক বিক্রিয়াগুলি লেখো।

(c) Discuss how dopants increase conductivity of the conducting polymers. Discuss the structure and applications of Polyacetylene and Polypyrrole. 2+3

ডোপান্টগুলি কীভাবে তড়িৎ পরিবাহী পলিমারগুলির পরিবাহিতা বৃদ্ধি করে আলোচনা করো। পলিঅ্যাসিটিলিন এবং পলিপাইরোল-এর গঠনাকৃতি ও গুরুত্বপূর্ণ ব্যবহার লেখো।

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within* 1 *hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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WEST BENGAL STATE UNIVERSITY

B.Sc. Programme 5th Semester Examination, 2021-22

CEMGDSE02T-CHEMISTRY (DSE1)

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.

প্রান্তিক সীমার মধ্যস্থ সংখ্যাটি পূর্ণমান নির্দেশ করে। পরীক্ষার্থীরা নিজের ভাষায় যথা সম্ভব শব্দসীমার মধ্যে উত্তর করিবে।

All symbols are of usual significance.

Answer any *two* questions taking *one* from the each Group

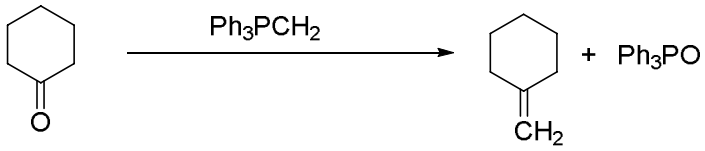
GROUP-A

1. (a) Why do we need Green Chemistry? What are the limitations in the implementation of green chemistry? 2+2

সবুজ রসায়নের প্রয়োজনীয়তা কি ? সবুজ রসায়ন প্রয়োগের সীমাবদ্ধতাগুলি কি ?

(b) Giving the formula for % atom economy, calculate the % atom economy of the following reaction: 3

% পরমাণু অর্থনীতির সমীকরণটি লেখো। নিম্নলিখিত বিক্রিয়াটির জন্য % পরমাণু অর্থনীতি গণনা করো।



Atomic Mass: C=12; H=1; O=16; P=31

(c) (i) Discuss the advantages of use of water as solvent in comparison to organic solvents. 2

জৈবদ্রাবকের পরিবর্তে জলকে দ্রাবক হিসেবে ব্যবহারের সুবিধাগুলি আলোচনা করো।

(ii) What is cohesive energy density (CED)? 2

সমন্বিত শক্তি ঘনত্ব কি ?

(iii) What should be the basic criteria for a solvent to be a Green solvent? 2

কোনো দ্রাবকের সবুজ দ্রাবক হওয়ার শর্তাবলীগুলি লেখো।

(iv) What do you understand by the term PEG-400? Write one advantage of PEG using as solvent. 2+1

PEG-400 বলতে কি বোঝো ? PEG-কে দ্রাবক হিসেবে ব্যবহারের একটি সুবিধা লেখো।

(d) What are the advantages of solvent free reaction? Give one example of solvent free reaction. 2+1

দ্রাবকবিহীন বিক্রিয়ার সুবিধাগুলি লেখো। একটি দ্রাবকবিহীন বিক্রিয়ার উদাহরণ দাও।

(e) What is renewable feedstock? Explain with suitable examples. 2+3

রিনিয়্যাবল ফিডস্টোক কি ? উপযুক্ত উদাহরণের সহায়তায় ব্যাখ্যা করো।

2. (a) Describe the role of solvent and catalyst for designing a green chemical reaction. 2+2

গ্রীন রাসায়নিক বিক্রিয়ার পরিকল্পনায় দ্রাবক ও অনুঘটকের ভূমিকা বর্ণনা করো।

(b) Write the names of two green house gases. Discuss about the social benefits of green building. 1+3

দুটি গ্রীনহাউস গ্যাসের নাম লেখো। গ্রীনভবনের সামাজিক উপকারিতা সম্বন্ধে আলোচনা করো ।

(c) Explain the term "Shorter synthesis avoiding derivatisation" with the help of a suitable example. 3

উপযুক্ত উদাহরণের সহায়তায় "ডেরিভেটাইজেশন এড়িয়ে সংক্ষিপ্ত সংশ্লেষণ", এই উক্তিটির ব্যাখ্যা করো।

(d) What is photocatalytic reaction? Give an example of it. 1+2

ফটোক্যাটালাইটিক বিক্রিয়া কি ? একটি উদাহরণ দাও ।

(e) What is thermal and non-thermal effect of microwave? 4

মাইক্রোওয়েভের তাপীয় ও তাপবিহীন প্রভাব কি ?

(f) What are the utilities of sonochemical reaction over conventional heating process? 3

প্রচলিত উত্তাপন প্রক্রিয়া অপেক্ষা সোনোকেমিক্যাল বিক্রিয়ার উপযোগিতাগুলি কি ?

(g) Describe the safer route to synthesis of Carbaryl. 3

কার্বারাইল প্রস্তুতির নিরাপদ পদ্ধতি বর্ণনা করো।

GROUP-B

3. (a) Write short notes on: 3×3 = 9

সংক্ষিপ্ত টীকা লেখোঃ

(i) Safe marine antifoulants

নিরাপদ সামুদ্রিক অ্যান্টিফাউল্যান্ট

(ii) Microwave-assisted oxidation of alcohols

মাইক্রোওয়েভের সহায়তায় অ্যালকোহলের জারণ বিক্রিয়া

(iii) Greener route to Diels-Alder reaction.

ডিলস-আলডার বিক্রিয়ার গ্রীনপদ্ধতি।

(b) Give the greener route to replace the conventional synthesis of disodium iminodiacetate. 2

প্রথাগত পদ্ধতির পরিবর্তে ডাইসোডিয়াম ইমিনোডাইআসিটেট-এর সবুজসংশ্লেষণ পদ্ধতি আলোচনা করো।

(c) Why PLA is called compostable biodegradable polymer? 2

কেন PLA-কে কম্পোস্টেবল বায়োডিগ্রেডেবল পলিমার বলা হয় ?

(d) What is the green method for dry cleaning? What is the drawback of conventional dry cleaning method? 2+1

শুষ্ক পরিষ্করণ-এর সবুজপদ্ধতি কি ? প্রথাগত শুষ্ক পরিষ্করণ পদ্ধতির সীমাবদ্ধতা কি ?

4. (a) What is combinatorial chemistry? Describe its application in green chemistry. 1+2

সমন্বিত রসায়ন কি ? গ্রীন কেমিস্ট্রিতে ইহার প্রাসঙ্গিকতা বর্ণনা করো।

(b) Discuss the role of Green chemistry in sustainable development. 2

অব্যাহত উন্নয়নে গ্রীন কেমিস্ট্রির ভূমিকা আলোচনা করো।

(c) Give example of multifunctional reagents and catalysts used in green organic syntheses. 2

গ্রীন জৈবসংশ্লেষণে ব্যবহৃত বহুগুণসম্পন্ন বিকারক ও অনুঘটকের উদাহরণ দাও।

(d) Write short notes on: 3×3 = 9

সংক্ষিপ্ত টীকা লেখোঃ

(i) Rightfit pigment

সঠিক রঞ্জক

(ii) Microwave assisted hydrolysis of methyl benzoate

মাইক্রোওয়েভ-এর সহায়তায় মিথাইলবেঞ্জোয়েট-এর আর্দ্রবিশ্লেষণ

(iii) Cradle to Cradle Carpeting.

ক্রাডল টু ক্রাডল কারপেটিং।

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 1st Semester Examination, 2021-22

CEMACOR01T-CHEMISTRY (CC1)

ORGANIC CHEMISTRY-I

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-1

1. (a) Draw the orbital picture of O_2N-CH_2-CHO and mention the state of hybridization of each atom except hydrogens. 3

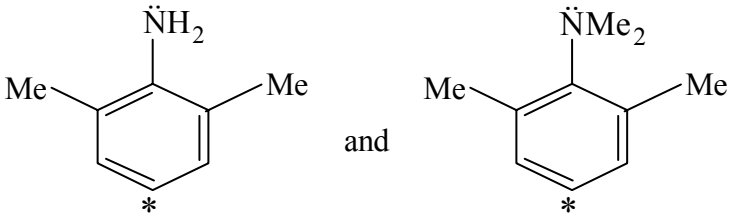
   (b) Draw all possible canonical forms of $\mathbf{EtO_2C-\overline{C}H-\overset{+}{N}\equiv N}$ and justify which one is the most stable structure among them. 3

   (c) Draw a properly labelled π-molecular orbital diagram of allylic anion. Indicate the HOMO and LUMO of the molecule in the ground state. 3

   (d) Arrange the following compounds in order of their increasing heat of hydrogenation values with proper reason. 3

   1-hexene, *cis*-3-hexene, *trans*-3-hexene

   (e) Which compound among the following pair has higher electron density at the marked carbon atom? 3



   (f) Calculate the DBE for the molecule with molecular formula $C_{10}H_7Cl$. 1

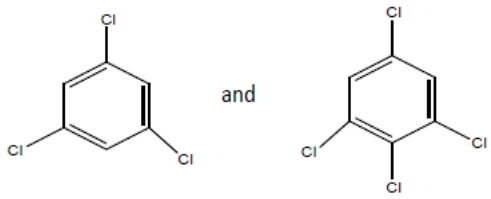
2. (a) Three isomeric pentane molecules have boiling points 9.5°C, 28°C and 36°C. Match each boiling point with correct isomers and give reason. 3

   (b) Show the species formed in the following two cases and also comment on their stability. 4

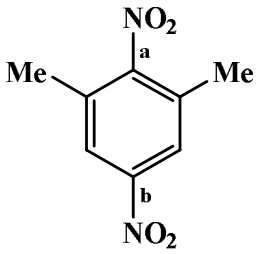
   (i) Cyclooctatetraene is reacted with conc. H_2SO_4

   (ii) 1,3-cyclopentadiene is reacted with NaOH.

(c) Which one of the following pair has the higher dipole moment and why? 2



(d) Compare the bond lengths (a vs b) of the following compound with reason. 3



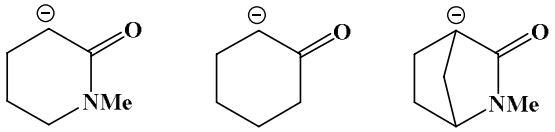
(e) Compare dipole moments of NH_3, NF_3 and BF_3 with explanation. 2

(f) Draw the Frost diagram for the π-MOs of square planar cyclobutadiene. 2

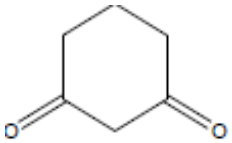
UNIT-2

3. (a) Compare the order of nucleophilicity of NH_3, H_2O and H_2N-NH_2. 2

(b) Explain the order of stability of the following anions. 2



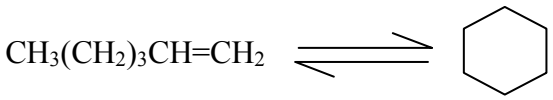
(c) The following compound is readily soluble in aq NaOH but not in water.—Explain. 2



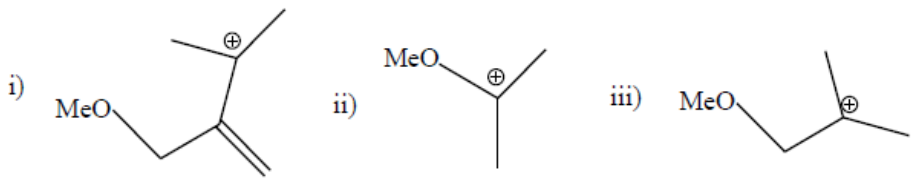
(d) Compare the stability of the following radicals. 2

$\dot{C}F_3$, $\dot{C}H_2F$, $\dot{C}H_3$

4. (a) Predict the sign of the entropy change for the following transformation and justify. 2



(b) Give the correct order of stability of the following carbocations with explanation. 2



(c) What are pericyclic reactions? Explain with one example. 2

(d) Nucleophiles may be charged or neutral species — Justify. 2

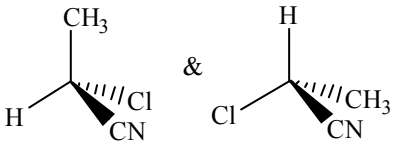
UNIT-3

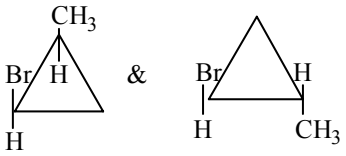
5. (a) Define alternating axis of symmetry with an example. 2

(b) Draw the following as directed. 2

Erythro-3-amino-2-butanol (*anti*-form in Sawhorse representation)

(c) Label the following pair of molecules as homomer, enantiomer or diastereomer with reason 2+2

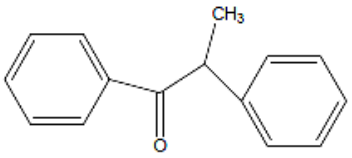
(i) 

(ii) 

(d) Specific rotation of an enantiomeric mixture is (+) 15.90 and the specific rotation of the R-enantiomer is –38.90, determine the percentage of each isomer in the mixture. 3

(e) Define the term "Stereogenic center". Are centres of stereogenicity always centres of chirality? Explain with suitable example. 3

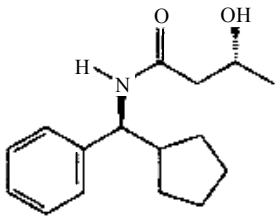
(f) The following optically active ketone loses its optical activity when treated with a little base. Explain showing the mechanism. 2

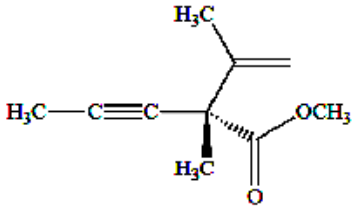


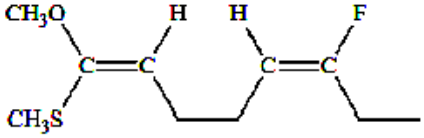
6. (a) What is diastereoisomer? Explain with an example. 2

(b) Give examples of molecules having D_{3h} and C_{3h} point groups. 2

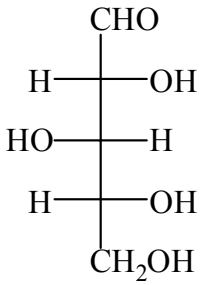
(c) Label each sp^3 stereocenter, as *R* or *S* and each alkene as *E* or *Z*. 1+1+2

i) 

ii) 

iii) 

(d) Convert the following Fischer projection to *zig-zag* projection. 3



(e) What are the symmetry elements present in *trans*-1,2-dichloroethene? 2

(f) Explain whether the following compounds are resolvable or not? 3

(i) $H_3CHC=C=CHCH_3$ (ii) PhN(Me)Et.

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours/Programme 1st Semester Examination, 2021-22

CEMHGEC01T/CEMGCOR01T-CHEMISTRY (GE1/DSC1)

Time Allotted: 2 Hours | Full Marks: 40

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

প্রান্তিক সীমার মধ্যস্থ সংখ্যাটি প্রশ্নের মান নির্দেশ করে।
পরীক্ষার্থীদের নিজের ভাষায় যথা সম্ভব শব্দসীমার মধ্যে উত্তর দিতে হবে।

All symbols are of usual significance.

SECTION-A
বিভাগ-ক

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

UNIT-I

1. (a) Write Bohr's equation regarding energy of an electron of hydrogen atom and explain the terms involved. How was Bohr's atomic model modified by Somerfield's theory? 2+2

হাইড্রোজেন পরমাণুর ইলেকট্রনের শক্তি সম্পর্কিত বোর-এর সমীকরণটি লেখো এবং তার বিভিন্ন পদগুলি ব্যাখ্যা করো। সমারফিল্ড কিভাবে বোর-এর তত্ত্বটি সংশোধন করেন ?

(b) Write the electronic configuration of an element with atomic number 29 and hence predict the position of the element in the periodic table. 1+1

29 পরমাণুক্রমাঙ্কবিশিষ্ট মৌলের ইলেকট্রন বিন্যাস লেখো। পর্যায়সারণিতে এর অবস্থান নির্দেশ করো।

2. (a) Write Aufbau Principle and write the four quantum numbers for the outermost electron of Cr-atom. 2+2

আউফবাউ-এর নীতিটি লেখো এবং Cr পরমাণুর সর্ববহিঃস্থ ইলেকট্রনের চারটি কোয়ান্টাম সংখ্যা লেখো।

(b) Calculate the wave number of radiation absorbed when an electron jumps from first Bohr orbit to second Bohr orbit in a hydrogen atom. 2
[Rydberg constant = 109700 cm^{-1}]

হাইড্রোজেন পরমাণুর প্রথম বোর কক্ষ থেকে দ্বিতীয় বোর কক্ষে একটি ইলেকট্রনের স্থানান্তরজনিত বিকিরণের তরঙ্গ সংখ্যা নির্ণয় করো। [রিডবার্গ ধ্রুবক R = 109700 cm^{-1}]

UNIT-II

3. (a) Discuss the position of noble gases in the periodic table. 2

পর্যায়সারণিতে নোবেল গ্যাসগুলির অবস্থান আলোচনা করো।

(b) Compare the first ionization potential of Na and Mg. 2

Na এবং Mg-এর প্রথম আয়নীভবন বিভব মানের তুলনা করো।

4. (a) With proper explanation write the increasing order of ionic radii for the following species: 2

কারণসহ ক্রমবর্ধমান আয়নীয় ব্যাসার্ধ অনুসারে নিম্নলিখিত আয়নগুলিকে সাজাওঃ

N^{3-}, O^{2-}, F^{-}, Na^{+}

(b) What is electronegativity? Arrange the following elements with increasing order of electronegativity: 2

F, Cl, Br, I

ইলেক্ট্রোনেগেটিভিটি কি ? নিচের মৌলগুলিকে ক্রমবর্ধমান ইলেক্ট্রোনেগেটিভিটি অনুসারে সাজাওঃ

F, Cl, Br, I

UNIT-III

5. (a) State Bronsted and Lowry concept of acids and bases with examples. 3

উদাহরণসহ ব্রনস্টেড এবং লাউরির অ্যাসিড ক্ষারনীতি বিবৃত করো।

(b) Following Lux-Flood concept identify the acid and base in the equation below. 1

লাক্স-ফ্লাড মতানুসারে নিম্নলিখিত সমীকরণটির অম্ল ও ক্ষারককে সনাক্ত করো।

$$CaO + SiO_2 = CaSiO_3$$

(c) Give conjugate acids and bases of the following: 2

নিম্নলিখিতগুলির অনুবন্ধী অম্ল বা ক্ষারগুলি লেখোঃ

H_2CO_3 , NH_2CONH_2 , HSO_4^- , H_2O

6. (a) Water acts as Lewis acid and Lewis base. Explain. 2

জল লুইস অ্যাসিড এবং লুইস ক্ষার দুভাবেই কাজ করে। ব্যাখ্যা করো।

(b) Arrange the following hydracids in order of their acid-strength and explain. 2

নিম্নলিখিত হাইড্রাসিডগুলিকে আম্লীকতার ক্রমানুসারে সাজাও ও ব্যাখ্যা করো।

HF, HCl, HBr, HI

(c) What do you mean by 'levelling effect'? 2

লেভেলিং এফেক্ট বলতে কী বোঝো ?

UNIT-IV

7. (a) Balance the following reactions using Ion electron method. 2

নিচের রাসায়নিক সমীকরণটি আয়ন ইলেকট্রন পদ্ধতিতে সমতা বিধান করো।

$$KMnO_4 + H_2SO_4 + (COOH)_2 \rightarrow K_2SO_4 + MnSO_4 + H_2O + CO_2\uparrow$$

(b) Calculate the oxidation number of: (i) I in $H_2IO_6^{3-}$ and (ii) Fe in $Fe(CO)_5$ 1+1

জারণ সংখ্যা চিহ্নিত করোঃ (i) $H_2IO_6^{3-}$ যৌগটিতে I এর এবং (ii) $Fe(CO)_5$ যৌগটিতে Fe এর।

8. (a) Balance the following reactions using oxidation number method. 2

নিচের রাসায়নিক সমীকরণটি জারণ সংখ্যা পদ্ধতিতে সমতা বিধান করো।

$$I_2 + Na_2S_2O_3 \rightarrow NaI + Na_2S_4O_6$$

(b) Calculate the equivalent weight of $KMnO_4$ in acid medium considering the molecular weight of $KMnO_4$ = m. 2

$KMnO_4$ এর আণবিক ওজন = m ধরে, অ্যাসিড মাধ্যমে $KMnO_4$ এর তুল্যাঙ্কভার গণনা করো।

SECTION-B

বিভাগ-খ

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

UNIT-I

9. (a) Why C2-C3 bond length is shorter in propene than in propane? 2
প্রোপেন এর চেয়ে প্রপিনে C2-C3 বন্ড দৈর্ঘ্য কম কেন ?

(b) Compare the stabilities of $(CH_3)_3\overset{\oplus}{C}$ and $Me\overset{\oplus}{C}HEt$ with reasons. 2
কারণসহযোগে $(CH_3)_3\overset{\oplus}{C}$ এবং $Me\overset{\oplus}{C}HEt$ -এর স্থায়ীত্ব তুলনা করো।

10.(a) Compare the stabilities of $CH_3\overset{\ominus}{C}H_2$ and $Ph\overset{\ominus}{C}H_2$ with reasons. 2
কারণসহযোগে $CH_3\overset{\ominus}{C}H_2$ এবং $Ph\overset{\ominus}{C}H_2$ -এর স্থায়ীত্ব তুলনা করো।

(b) Define electrophile and nucleophile with examples. 2
উদাহরণসহযোগে ইলেক্ট্রোফাইল এবং নিউক্লিওফাইল-এর সংজ্ঞা দাও।

UNIT-II

11.(a) What is chiral center? How many chiral centers are there in meso-2,3-dichlorobutane? Is this molecule chiral? If not, why? 3
কাইরাল বিন্দু কি ? মেসো-2,3-ডাইব্রোমোবিউটেনে কটি কাইরাল বিন্দু আছে ? এই অণুটি কি কাইরাল ? যদি না হয় কেন ?

(b) Write down the Fischer and Newman projection formulae of meso-2,3-dihydroxybutane. 2
মেসো-2,3-ডাইহাইড্রক্সিবিউটেনের ফিশার ও নিউম্যান অভিক্ষেপ সংকেত লেখো।

12.(a) Write down the structures of 3
(i) R-2-bromobutane, (ii) E-2-pentene, (iii) D-glyceraldehyde.
সংকেত লেখোঃ
(i) R-2-ব্রোমোবিউটেন, (ii) E-2-পেন্টিন, (iii) D-গ্লিসারালডিহাইড।

(b) D and L-tartaric acid are optically active but meso-tartaric acid is optically inactive. — Explain. 2
D এবং L-টার্টারিক অ্যাসিড আলোক সক্রিয় কিন্তু মেসো-টার্টারিক অ্যাসিড আলোক সক্রিয় নয়। – ব্যাখ্যা করো।

UNIT-III

13.(a) Write short note on Hofmann elimination. 2
হফম্যান অপনয়ন-এর উপর সংক্ষিপ্ত টীকা লেখো।

(b) Between S_N1 and S_N2 reactions whose rate depends on the concentration of nucleophile? — Why? 2
S_N1 এবং S_N2 বিক্রিয়ার মধ্যে কোন্‌টির হার নিউক্লিওফাইলের গাঢ়ত্বের উপর নির্ভর করে ? – কেন ?

14.(a) Which of the following S_N1 reactions would you expect to take place more rapidly? Explain. 2

নিচের S_N1 বিক্রিয়াগুলোর মধ্যে কোন্‌টি আরও দ্রুত ঘটবে বলে তুমি আশা করো ? ব্যাখ্যা দাও।

(i) $(CH_3)_3C\text{-}I + CH_3OH \rightarrow (CH_3)_3COCH_3 + HI$

(ii) $(CH_3)_3C\text{-}Cl + CH_3OH \rightarrow (CH_3)_3COCH_3 + HCl$

(b) Explain E2 reaction with examples. 2

উদাহরণসহ E2 বিক্রিয়া ব্যাখ্যা করো।

UNIT-IV

15.(a) Predict the major product of the following reaction and explain your choice. 2

নিচের বিক্রিয়াটিতে উৎপন্ন মুখ্য বিক্রিয়াজাত পদার্থটি কি নির্ধারণ করো এবং তোমার পছন্দের ব্যাখ্যা দাও।

$$CH_3OCH = CHCH_3 + HBr \longrightarrow$$

(b) How will you prepare the following? 2+2

নিচেরগুলি কিভাবে প্রস্তুত করবে ?

(i) Acetone from acetylene

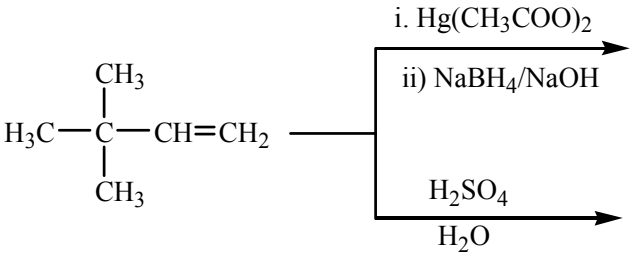
(ii) 2-Butyne from propane.

(c) How will you prepare 2^o alcohols from Grignard reagent? 1

গ্রিগনার্ড বিকারক থেকে কিভাবে 2^o অ্যালকোহল তৈরি করবে ?

16.(a) Write down the products in the following reactions: 2+2

নিচের বিক্রিয়াগুলিতে উৎপন্ন পদার্থগুলি লেখোঃ



(b) What is ozonolysis? Give the name and structural formula of the compound which on ozonolysis followed by hydrolysis gives acetone and propionaldehyde. 1+2

ওজোনোলাইসিস কি ? যে যৌগটির ওজোনোলাইসিস এবং আর্দ্র বিশ্লেষণ-এর পর অ্যাসিটোন এবং প্রপ্রিয়নালডিহাইড উৎপন্ন হয় তার নাম ও গঠন সংকেত লেখো।

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours/Programme 2nd Semester Supplementary Examination, 2021

CEMHGEC02T/CEMGCOR02T-CHEMISTRY (GE2/DSC2)

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.

SECTION-A

Answer *four* questions taking *one* from each unit

প্রত্যেক ইউনিট থেকে *একটি* করে নিয়ে মোট *চারটি* প্রশ্নের উত্তর দাও

Unit-I

1. (a) Write down the Maxwell's equation for distribution of molecular speeds in three dimensions and explain the terms. Show graphically how the velocity distribution curves vary at two different temperatures T_1 and T_2 $(T_1 > T_2)$ for the same gas. 2+2

ম্যাক্সওয়েলের আণবিক গতিবন্টনের ত্রিমাত্রিক সমীকরণটি লেখো এবং প্রতিটি পদ ব্যাখ্যা করো। একই গ্যাসের ক্ষেত্রে দুটি পৃথক T_1 ও T_2 $(T_1 > T_2)$ তাপমাত্রায় গতি বন্টনের আকৃতির কিরূপ পরিবর্তন হবে লেখচিত্রের মাধ্যমে দেখাও।

(b) Write mathematical expression for mean free path of a gas. How does the mean free path of a gas change with rise in temperature at constant pressure? 1+1

কোনো গ্যাসের গড় মুক্ত পথের গাণিতিক রূপটি লেখো। স্থির চাপের উষ্ণতা বৃদ্ধির সাথে গড় মুক্ত পথ কিভাবে পরিবর্তিত হয় ?

2. (a) State the principle of equipartition of energy. Calculate the translational kinetic energy of a molecule of an ideal gas. 1+1

শক্তির সমবিভাজন নীতি বিবৃত করো। আদর্শ গ্যাসের একটি অনুসরণ গতিশক্তি গণনা করো।

(b) Calculate RMS speed of oxygen at 0°C. 2

0°C উষ্ণতায় অক্সিজেনের গড় দ্বিঘাতিয় বর্গমূল নির্ণয় করো।

(c) Write down van der Waals equation in case of 'n' mole of a real gas. What is meant by compressibility factor Z ? 1+1

'n' মোল বাস্তব গ্যাসের জন্য ভ্যানডারওয়ালসের সমীকরণটি লেখো। সংনম্যতা গুণক Z বলতে কি বোঝায় ?

Unit-II

3. (a) Define coefficient of viscosity of a liquid. Write its SI unit. Determine its dimension. 1+1+1

তরলের সান্দ্রতা গুণকের সংজ্ঞা দাও। ইহার একক লেখো। SI পদ্ধতিতে ইহার মাত্রা নির্ধারণ করো।

(b) Which instrument are used for measuring viscosity of a liquid? 1
কোন যন্ত্র ব্যবহার করে তরলের সান্দ্রতা মাপা হয় ?

4. (a) Define Surface Tension. Determine its dimension. 1+1
পৃষ্ঠটানের সংজ্ঞা দাও। ইহার মাত্রা নির্ধারণ করো।

(b) How do surface tension and viscosity of a liquid vary with rise in temperature? 2
কোন তরলের পৃষ্ঠটান এবং সান্দ্রতা উষ্ণতা বৃদ্ধির সাথে কিভাবে পরিবর্তিত হয় ?

Unit-III

5. (a) What is meant by the plane of symmetry of a crystal? 1
কেলাসের প্রতিসাম্য তল বলতে কি বোঝো ?

(b) Calculate the no. of atoms per unit cell of a face-centred cubic lattice. 2
কেলাসের পৃষ্ঠকেন্দ্রিক কাঠামোর প্রতি একক কোষের পরমাণুর সংখ্যা গণনা করো।

(c) What is meant by the Miller Indices of a crystal? 1
একটি কেলাসের মিলার সূচক বলতে কি বোঝো ?

6. (a) What do you mean by the unit cell of a crystal? 1+2+1
একটি কেলাসের একক কোষ বলতে কি বোঝো ?

(b) The Weiss indices of a plane of a cubic crystal are found to be $1:\infty:\infty$; find the miller indices of the plane.
একটি ঘনকাকার কেলাসের একটি তলের ওয়েসিস সূচক হল $1:\infty:\infty$; এর মিলার সূচকগুলি নির্ণয় করো।

(c) State the Steno's Law of constancy of crystal angles of a solid crystal.
কঠিন কেলাসের পৃষ্ঠতলের মধ্যবর্তী কোণের ধ্রুবকতা সম্পর্কিত স্টেনোর সূত্রটি লেখো।

Unit-IV

7. (a) What is Molecularity? Write down some differences between Molecularity and Order of a reaction. 2+2+2
আণবিকতা কাকে বলে ? একটি বিক্রিয়ার আণবিকতা এবং ক্রমের মধ্যে পার্থক্যগুলো লেখো।

(b) If order of a reaction is $3/4$ then what would be the unit of rate constant k.
যদি একটি বিক্রিয়ার ক্রম $3/4$ হয়, ঐ বিক্রিয়াটির গতি ধ্রুবকের একক নির্ধারণ করো।

(c) For a first order reaction $(t_{1/2})$ is 30 minutes. Calculate the rate constant of the reaction.
একটি প্রথম ক্রম বিক্রিয়ার অর্ধবিয়োজন কাল 30 মিনিট বিক্রিয়াটির গতি ধ্রুবক নির্ণয় করো।

8. (a) Write equation of rate constant of a zero order reaction. Write unit of rate constant of a first order reaction. 2+2+2
শুন্য ক্রম বিক্রিয়ার গতি ধ্রুবকের সমীকরণটি লেখো। প্রথম ক্রম বিক্রিয়ার গতি ধ্রুবকের এককটি লেখো।

(b) A first order reaction is 24.0% complete in 19.7 minutes. How long will the reaction take to be 90.0% complete?

একটি প্রথম বিক্রিয়ার 24.0% বিয়োজন ঘটে 19.7 মিনিটে। তাহলে ঐ বিক্রিয়াটির 90.0% বিয়োজিত হতে কতক্ষণ সময় প্রয়োজন হবে ?

(c) Write down the expression of temperature dependence in Arrhenius equation on reaction rate explaining the terms involved.

ব্যবহৃত প্রতীকগুলির ব্যাখ্যাসহ বিক্রিয়া হারের উষ্ণতার উপর নির্ভরশীলতার আরহেনিয়াসের সমীকরণটি লেখো।

SECTION-B

Answer *two* questions taking *one* from each unit

প্রত্যেক ইউনিট থেকে *একটি* করে নিয়ে মোট *দুটি* প্রশ্নের উত্তর দাও

Unit-I

9. (a) Define Lattice energy. Write Born-Lande equation mentioning the terms involved in it. 1+2

জালাক শক্তির সংজ্ঞা লেখো। Born-Lande সমীকরণটি লেখো। এর মধ্যেকার পদগুলির পরিচয় দাও।

(b) $PbCl_2$ is crystalline solid but $PbCl_4$ is liquid — Explain. 2

$PbCl_2$ কেলাসাকার কঠিন কিন্তু $PbCl_4$ তরল – ব্যাখ্যা করো।

(c) Predict the shapes of the following compounds on the basis of VSEPR theory: 3×2

(i) NH_3 (ii) BF_3 (iii) SF_4

VSEPR তত্ত্বের সাহায্যে নিম্নলিখিত যৌগগুলির গঠনের বর্ণনা দাও।

(i) NH_3 (ii) BF_3 (iii) SF_4

10.(a) How many types of hydridization are possible with *s*-and *p*-orbitals? Give one example of each. 3

s এবং *p*-কক্ষকের সংযোগে কতপ্রকার সংকরায়ণ সম্ভব। প্রতিটির একটি উদাহরণ দাও।

(b) Carbondi-oxide is non-polar whereas water molecule is polar — Explain. 2

কার্বনডাই-অক্সাইড অধ্রুবীয় অথচ জলধ্রুবীয় – ব্যাখ্যা করো।

(c) Give an outline of the Born-Haber cycle for the formation of NaCl crystal from Sodium metal and Chlorine gas. 3

ধাতব সোডিয়াম এবং গ্যাসীয় ক্লোরিন থেকে সোডিয়াম ক্লোরাইড গঠনের ক্ষেত্রে Born-Haber চক্রের নকশা চিত্র অঙ্কন করো।

(d) Write the Molecular Orbital electronic configuration of O_2 and O_2^+ and hence predict which one among them will be paramagnetic. 2+1

O_2 এবং O_2^+ এর আণবিক কক্ষকের (Molecular Orbital) ইলেক্ট্রন বিন্যাস লেখো। এদের মধ্যে কোনটি পরাচৌম্বকধর্মী ?

Unit-II

11.(a) Give a comparative study of C, Si and Ge with respect to their (i) oxides (ii) hydrides. 2+2

C, Si এবং Ge মৌলসমূহের (i) অক্সাইড (ii) হাইড্রাইডের সাপেক্ষে তুলনামূলক আলোচনা করো।

(b) Compare the Lewis acidities of BF_3 and BCl_3 with explanation. 3

BF_3 এবং BCl_3 এর লুইস অম্লীকতা ব্যাখ্যাসহ তুলনা করো।

(c) Basicity of NH_3 more basic than that of PH_3 — Explain. 2

ফসফিন অপেক্ষা অ্যামোনিয়া বেশি ক্ষারীয় – ব্যাখ্যা করো।

12.(a) Discuss the hydrides of nitrogen and phosphorous in a comparative manner. 3

নাইট্রোজেন এবং ফসফরাস মৌলসমূহের হাইড্রাইড যৌগগুলির তুলনামূলক আলোচনা করো।

(b) Explain why? 2×2

কারণসহ ব্যাখ্যা করো।

(i) $SnCl_4$ is a liquid but $SnCl_2$ is a solid at room temperature.

সাধারণ তাপমাত্রায় $SnCl_4$ একটি তরল কিন্তু $SnCl_2$ একটি কঠিন পদার্থ।

(ii) Both PCl_3 and PCl_5 are formed but only NCl_3 exists.

PCl_3 এবং PCl_5 উভয় যৌগ গঠিত হয় – কিন্তু শুধু NCl_3 পাওয়া যায়।

(c) Why SO_2 shows both oxidizing and reducing properties? 2

SO_2 জারণ ও বিজারণ উভয় ধর্ম প্রদর্শন করে কেন ?

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours/Programme 3rd Semester Examination, 2021-22

CEMHGEC03T/CEMGCOR03T-CHEMISTRY (GE3/DSC3)

Time Allotted: 2 Hours | Full Marks: 40

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

প্রান্তিক সীমার মধ্যস্থ সংখ্যাটি প্রশ্নের মান নির্দেশ করে।
পরীক্ষার্থীদের নিজের ভাষায় যথা সম্ভব শব্দসীমার মধ্যে উত্তর দিতে হবে।

All symbols are of usual significance.

SECTION-A

Answer any *three* questions taking *one* from each unit
প্রত্যেক ইউনিট থেকে *একটি* করে প্রশ্ন নিয়ে মোট *তিনটি* প্রশ্নের উত্তর দাও

UNIT-I

1. (a) In thermodynamics what do you mean by open system, closed system and isolated system? 3
তাপ গতিবিদ্যায় মুক্ত সিস্টেম, বদ্ধ সিস্টেম ও নিঃসঙ্গ সিস্টেম বলতে কি বোঝো ?

(b) Calculate maximum work in (i) ergs and in (ii) litre-atmosphere when 2 mole of an ideal gas expands isothermally at 27°C from 2 litres to 10 litres. 3
2 মোল কোনো আদর্শ গ্যাসকে 27°C উষ্ণতায় সমতাপীয়ভাবে 2 লিটার আয়তন থেকে 10 লিটার আয়তনে প্রসারিত করা হলে সর্বাধিক কৃতকার্যের পরিমাণ (i) আর্গ (ii) লিটার-অ্যাটমোস্ফিয়ার এককে নির্ণয় করো।

(c) Classify the following into intensive and extensive properties: 2
Mole fraction, Internal energy, Viscosity, Temperature.
নিম্নোক্ত ধর্মগুলিকে সংকীর্ণ এবং বিকীর্ণ ধর্ম হিসেবে শ্রেণীবদ্ধ করোঃ
মোল ভগ্নাংশ, আভ্যন্তরীণ শক্তি, সান্দ্রতা, তাপমাত্রা।

2. (a) Deduce T-V relationship of an ideal gas under reversible adiabatic condition. 3
আদর্শ গ্যাসের পরাবর্ত রুদ্ধতাপীয় পরিবর্তনের ক্ষেত্রে T-V সমীকরণটি প্রতিষ্ঠা করো।

(b) What are the thermodynamic criteria for (i) equilibrium (ii) spontaneity of a process? 2
(i) সাম্যাবস্থায় এবং (ii) স্বতঃস্ফূর্ত প্রক্রিয়ায় তাপগতীয় বৈশিষ্ট্য কি কি ?

(c) Establish Kirchhoff's equation related to heat of reaction and temperature. 2
বিক্রিয়া তাপের উপর উষ্ণতার প্রভাব সম্পর্কিত কারশফের সমীকরণ প্রতিষ্ঠা করো।

(d) What is heat of neutralization? 1
প্রশমন তাপ কি ?

UNIT-II

3. (a) For the reaction $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ find out the relation among K_p, α and P in the equilibrium condition. 3

এই বিক্রিয়াটির ক্ষেত্রে সাম্যাবস্থায় K_p, α ও P-এর মধ্যে সম্পর্ক নির্ধারণ করো।

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

(b) What is Le Chatelier principle? 1

লা শাতেলিয়ারের নীতি কি ?

(c) What is the effect of addition of inert gas on equilibrium in a gaseous reaction at constant volume? 2

স্থির আয়তনে কোনো গ্যাসীয় বিক্রিয়ায় নিষ্ক্রিয় গ্যাস যোগ করার ফলে সাম্যাবস্থার কি প্রভাব পড়ে ?

4. (a) Show the relation between K_p's of the following chemical equilibria: 3

নীচের বিক্রিয়া সাম্যগুলির K_p-এর মধ্যে সম্পর্ক দেখাও।

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

$$\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \rightleftharpoons NH_3(g)$$

(b) Discuss the effect of temperature and pressure on the equilibrium of the following reaction. 3

বিক্রিয়াটির ক্ষেত্রে সাম্যাবস্থায় উষ্ণতা এবং চাপের প্রভাব আলোচনা করো।

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + 22.08 \text{ Kcal.}$$

UNIT-III

5. (a) What do you mean by ionic product of water and how it is different from ionization constant of water. 3

জলের আয়নীয় গুণফল বলতে কী বোঝো ? জলের আয়নীয় গুণফল এবং আয়ন ধ্রুবকের মধ্যে প্রভেদ কি ?

(b) In a buffer solution concentration of NH_3 is 0.01 mole/litre and concentration of NH_4Cl is 0.02 mole/litre. Find out the pH ? [Given $K_b(NH_3) = 1.8\times10^{-5}$] 3

একটি বাফার দ্রবণের প্রতি লিটারে 0.01 মোল NH_3 ও 0.02 মোল NH_4Cl বর্তমান। দ্রবণটির pH কত ? [দেওয়া আছে $K_b(NH_3) = 1.8\times10^{-5}$]

6. (a) Deduce an expression for pH of the hydrolysis of an aqueous solution of a salt of strong acid and weak base. 3

একটি তীব্র অম্ল ও একটি মৃদু ক্ষারের লবণের জলীয় দ্রবণের আর্দ্রবিশ্লেষণে pH-এর সমীকরণটি প্রতিষ্ঠা করো।

(b) What is a buffer solution? Discuss the buffer action of a mixture of weak acid and its salt. 3

বাফার দ্রবণ কি ? একটি দুর্বল অ্যাসিড ও তার লবণ-এর মিশ্রণের বাফার অ্যাকশন বর্ণনা করো।

SECTION-B

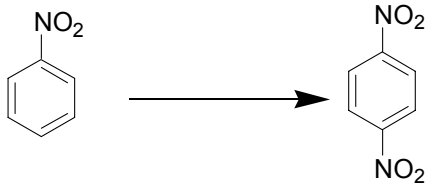
Answer any *four* questions taking *one* from each unit

প্রত্যেক ইউনিট থেকে *একটি* করে প্রশ্ন নিয়ে মোট *চারটি* প্রশ্নের উত্তর দাও

UNIT-I

7. (a) How will you carry out the following reaction? 2

নিম্নলিখিত বিক্রিয়াটি কিভাবে সম্পাদন করবে ?

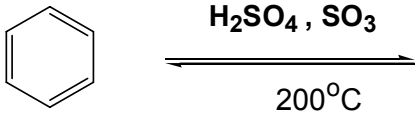


(b) Why polyalkylation happens in alkylation reaction of benzene by Friedel Crafts reaction? 2

ফ্রিডেল ক্রাফট অ্যালকাইলেশন বিক্রিয়াতে পলিঅ্যালকাইলেশন ঘটে কেন ?

8. (a) Complete the following Reaction. 2

নিম্নলিখিত বিক্রিয়াটি সম্পূর্ণ করো।



(b) How the following conversion could be carried out? 2

নিম্নলিখিত রূপান্তর কীভাবে সম্পন্ন করা যেতে পারে ?

(i) Benzene to Acetophenone.

UNIT-II

9. How will you prepare the following compounds using methyl magnesium iodide (CH_3MgI): $2\times2 = 4$

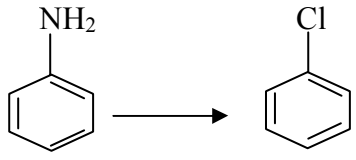
মিথাইল ম্যাগনেসিয়াম আয়োডাইড ব্যবহার করে কীভাবে নিম্নলিখিত যৌগগুলি প্রস্তুত করবে ?

(i) CH_3COOH (ii) $CH_3CHOHCH_3$

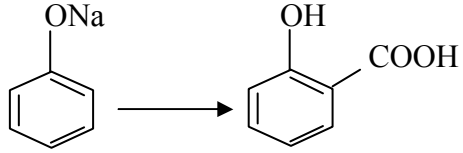
10. How would you prepare? $2\times2 = 4$

কিভাবে তৈরি করবে ?

(i)



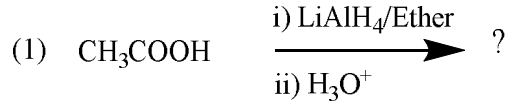
(ii)

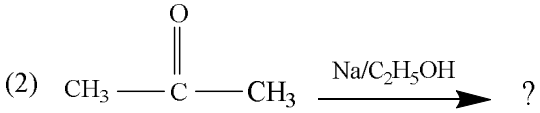


UNIT-III

11. (a) How would you distinguish chemically between 1°, 2° and 3° alcohols? 3
রাসায়নিক উপায়ে কিভাবে 1°, 2° ও 3° অ্যালকোহলের মধ্যে পার্থক্য নিরূপণ করবে ?

(b) Write down the product(s) of the following reactions: 2+2
নীচের বিক্রিয়াগুলিতে উৎপন্ন পদার্থ (গুলি) লেখো।





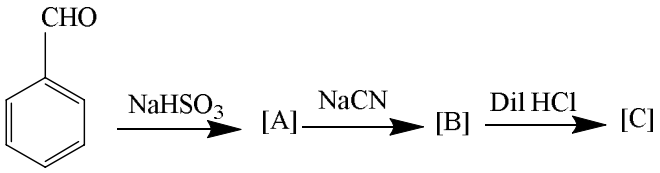
12. (a) Write notes on any ***two*** of the following: 2+2
নিম্নের বিষয়গুলির যে-কোনো ***দুটির*** উপর টীকা লেখোঃ

(i) Claisen rearrangement
ক্লেইজেন পুনর্গঠন বিক্রিয়া

(ii) Pinacol-pinacolone rearrangement
পিনাকল-পিনাকোলন বিক্রিয়া

(iii) Williamson's ether synthesis.
উইলিয়ামসন ইথার সংশ্লেষণ।

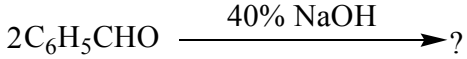
(b) Identify the product [A], [B] and [C] in the following reactions: 3
নিম্নের বিক্রিয়াগুলিতে [A], [B] এবং [C] সনাক্ত করো।



UNIT-IV

13. (a) How would you convert? 3
Benzaldehyde → Cinnamic Acid.
কিভাবে তৈরি করবে?
বেঞ্জালডিহাইড → সিনামিক অ্যাসিড।

(b) Complete the following reaction. 2
নিম্নলিখিত বিক্রিয়াটি সম্পূর্ণ করো।



14. (a) Ethyl alcohol and isopropyl alcohols both give positive iodoform test, comment on the statement. 2

ইথাইল অ্যালকোহল এবং আইসোপ্রোপাইল অ্যালকোহল উভয়ই ইতিবাচক আয়োডোফর্ম পরীক্ষা দেয়। বিবৃতির উপর মন্তব্য করো।

(b) Write note on: Benzoin condensation. 3

টীকা লেখোঃ Benzoin condensation.

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within* 1 *hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours/Programme 4th Semester Examination, 2021

CEMHGEC04T/CEMGCOR04T-CHEMISTRY (GE4/DSC4)

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.

SECTION-A

Answer *four* questions taking *one* from each unit

প্রত্যেক ইউনিট থেকে *একটি* করে নিয়ে মোট *চারটি* প্রশ্নের উত্তর দাও

Unit-I

1. (a) State and explain the Raoult's law of elevation of boiling point of a solution with a diagram. Write its mathematical form. 3

চিত্রের সাহায্যে রাউলটের স্ফুটনাঙ্কের উন্নয়ন সূত্রটি ব্যাখ্যা করো। এর গাণিতিক রূপটি লেখো।

(b) The vapour pressure of acetone at 20° C is 185 mm of mercury. Vapour pressure of a solution containing 1.2 g of a nonvolatile solute per 100 g of acetone is 182.5 mm of mercury at 20° C. What is the molecular weight of the solute? 2

20° C উষ্ণতায় অ্যাসিটোনের বাষ্পচাপ 185 mm (পারদ)। 100 গ্রাম অ্যাসিটোনে 1.2 গ্রাম একটি অনুদ্বায়ী পদার্থ দ্রবীভূত করায় 20° C উষ্ণতায় দ্রবণের বাষ্পচাপ হল 182.5 mm (পারদ)। পদার্থটির আণবিক ভর কত হবে ?

2. (a) What is critical solution temperature? Explain with an example. 2

সংকট দ্রবণ উষ্ণতা কাকে বলে ? একটি উদাহরণসহ বোঝাও।

(b) When a partially miscible liquid pair forms two conjugate layers at a definite temperature, then does addition of one liquid to it at the same temperature change the compositions of the layers? Give explanation. 2

একটি নির্দিষ্ট তাপমাত্রায় যদি একটি আংশিক মিশ্রিত তরল জোড়া দুটি সংহত স্তর তৈরী করে, তাহলে ঐ তাপমাত্রায় একটি তরল যোগ করলে ঐ স্তরের গঠন কি পরিবর্তন হবে ? ব্যাখ্যা দাও।

(c) Give one application of Nernst Distribution Law. 1

নার্নস্টের বণ্টন সূত্রটির একটি প্রয়োগ লেখো।

Unit-II

3. (a) Draw the labeled phase diagram of sulphur system and describe it. 3

বিভিন্ন অংশের নামসহ সালফারের দশাচিত্র অঙ্কন করো এবং বর্ণনা করো।

(b) Explain why melting point of ice decreases with rise in pressure. 2

চাপ বৃদ্ধিতে বরফের গলনাঙ্ক হ্রাস পায় কেন ব্যাখ্যা করো।

4. (a) What is eutectic point? Draw the phase diagram of a simple eutectic system and identify the different regions. 1+2

ইউটেকটিক বিন্দু কি ? একটি সাধারণ ইউটেকটিক সিস্টেমের দশাচিত্র অঙ্কন করে বিভিন্ন অঞ্চল চিহ্নিত করো।

(b) What is triple point? Calculate the degrees of freedom at the triple point in the phase diagram of water. 2

ত্রৈধ বিন্দু কি ? জলের দশাচিত্রের ত্রৈধ বিন্দুতে স্বাতন্ত্র্য মাত্রা নির্ণয় করো।

Unit-III

5. (a) Discuss how does the equivalent conductance of a solution vary with dilution for 3

(i) Strong electrolyte

(ii) Weak electrolyte

কোন দ্রবণের তুল্যাঙ্ক পরিবাহিতা তার লঘুতার সাথে কিভাবে পরিবর্তিত হয় ? আলোচনা করো।

(i) তীব্র তড়িৎবিশ্লেষ্য পদার্থের জন্য

(ii) মৃদু তড়িৎবিশ্লেষ্য পদার্থের জন্য

(b) At 25° C the conductance of 1N KCl solution was found to be 3.25 mmho by a certain conductivity cell. If specific conductance of 1N KCl is 0.01286 mho cm^{-1}, find the cell constant. Find also the equivalent conductance of 1N KCl. 2

25° C উষ্ণতায় একটি পরিবাহিতা কোষে 1N KCl দ্রবণ নিয়ে 3.25 mmho পরিবাহিতা পাওয়া গেল। যদি 1N KCl দ্রবণের আপেক্ষিক পরিবাহিতা 0.01286 mho cm^{-1} হয় তাহলে কোষ ধ্রুবক নির্ণয় করো। দ্রবণটির তুল্যাঙ্ক পরিবাহিতাও নির্ণয় করো।

6. (a) At 25° C and in infinite dilution the value of equivalent conductance of CH_3COOH, HCl and NaCl are 78.0, 384.0 and 109 $ohm^{-1}cm^2$ respectively. Calculate the equivalent conductance of CH_3COOH at infinite dilution at that temperature. 3

25° C তাপমাত্রায় CH_3COOH, HCl এবং NaCl-এর অসীম লঘুতায় তুল্যাঙ্ক পরিবাহিতার মান যথাক্রমে 78.0, 384.0 এবং 109 $ohm^{-1}cm^2$ হলে অ্যাসেটিক অ্যাসিডের জন্য অসীম লঘুতায় তুল্যাঙ্ক পরিবাহিতার মান কত ?

(b) State the Kohlrausch law. 2

কোহলরাশের সূত্রটি বর্ণনা করো।

Unit-IV

7. (a) What are reversible and irreversible cell? Give example. 3

একমুখী ও উভয়মুখী কোষ কি ? উদাহরণ দাও।

(b) Derive the Nernst equation of the following reaction taking place in voltaic cell 2
$aA + bB = cC + dD$

ভোল্টীয় কোষে সংঘটিত নিম্নলিখিত বিক্রিয়ার জন্য Nernst-এর সমীকরণটি উপপাদন করো।
$aA + bB = cC + dD$

8. (a) Standard reduction potential of $Cu^{++}|Cu$ and $Ag^{+}|Ag$ electrodes are 0.337 and 0.799 volt respectively. Construct a cell with the electrodes and find its standard e.m.f. 3

$Cu^{++}|Cu$ এবং $Ag^{+}|Ag$ তড়িৎদ্বার দুটির প্রমাণ বিজারণ বিভব যথাক্রমে 0.337 এবং 0.799 ভোল্ট। তড়িৎদ্বার দুটির সাহায্যে একটি কোষ গঠন করো ও কোষটির প্রমাণ e.m.f নির্ণয় করো।

(b) What do you understand by electrochemical series? Why does $AgNO_3$ solution turn blue when a Cu wire is dipped in it? 1+1

তড়িৎ রাসায়নিক শ্রেণি কি ? $AgNO_3$ দ্রবণে একটি তামার তারকে নিমজ্জিত করলে দ্রবণের বর্ণ নীল হয় কেন ?

SECTION-B

Answer *two* questions taking *one* from each unit

প্রত্যেক ইউনিট থেকে *একটি* করে নিয়ে মোট *দুটি* প্রশ্নের উত্তর দাও

Unit-I

9. (a) Mention the principle and reactions for gravimetric estimation of Zn^{2+}. 3

তৌলিক বিশ্লেষণের মাধ্যমে দ্রবণে উপস্থিত Zn^{2+} আয়নের পরিমাণ কিভাবে নির্ণয় করবে তার নীতি ও বিক্রিয়া উল্লেখ করো।

(b) What is a redox indicator? Which redox indicator can be used for the estimation of Fe^{2+} by $K_2Cr_2O_7$? Draw its oxidized and reduced forms mentioning the colours. 3

জারণ-বিজারণ নির্দেশক কি ? আয়তনমাত্রিক পদ্ধতিতে $K_2Cr_2O_7$ দ্বারা Fe^{2+}-এর পরিমাণ নির্ণয় করতে কোন্ জারণ-বিজারণ নির্দেশক ব্যবহার করা যায় ? এর জারিত ও বিজারিত রূপ চিত্রায়িত করো ও বিভিন্ন রূপের বর্ণগুলি লেখো।

(c) Define R_f value. Why thin layer chromatography is superior to paper chromatography? 2+2

R_f -এর সংজ্ঞা লেখো। সরু স্তরের ক্রোমাটোগ্রাফির তুলনায় কাগজ ক্রোমাটোগ্রাফি সুবিধাজনক কেন ?

10.(a) Define co-precipitation and post precipitation in the context of gravimetric analysis. Give relevant examples. 2+1

কো-অধক্ষেপ ও পোস্ট অধক্ষেপ কি ? উদাহরণ দাও।

(b) Which primary standard solution is used for the standardization of EDTA? Which indicator is used for this titration? 1+1

EDTA দ্রবণের মাত্রা নির্ণয় করার জন্য কোন্ মুখ্য প্রমাণ দ্রবণ ব্যবহার করা হয় ? এই পদ্ধতিতে কোন্ নির্দেশক ব্যবহার করা হয় ?

(c) Mention the desired properties of a primary standard in volumetric analysis. Why is $KMnO_4$ not used as primary standard? 2+1

অনুমাপন পদ্ধতিতে ব্যবহৃত মুখ্য প্রমাণ পদার্থের ধর্মগুলি লেখো। $KMnO_4$ কেন মুখ্য প্রমাণ পদার্থ হিসাবে ব্যবহৃত হয় না ?

(d) What is common ion effect? 2

Common ion প্রভাব বলতে কি বোঝো ?

Unit-II

11.(a) How does ozone layer depletion occur? Discuss the harmful effects of it. 2+2

ওজোনস্তরের ক্ষয় কিভাবে হয় ? এর ক্ষতিকারক দিকগুলি লেখো।

(b) What is photochemical smog? 2

আলোক রাসায়নিক স্মোগ কি ?

(c) What are the causes of soil pollution? 2

মাটি দূষণের কারণগুলি লেখো।

(d) What do you mean by BOD? 2

বি ও ডি কি ?

12.(a) Discuss how water resources get polluted due to industrial effluents and agricultural runoff. 2+2

শিল্প ও কৃষিজ বর্জ্য দ্বারা জল কিভাবে দূষিত হয় ?

(b) Why hard water cannot form 'foam' with soaps easily? 2

ক্ষরজল সাবানে সহজে ফেনা উৎপন্ন করে না কেন ?

(c) What is acid rain? 2

অম্লবৃষ্টি কি ?

(d) Write a note on Bhopal Gas Tragedy. 2

টীকা লেখো ভোপাল গ্যাস বিপর্যয়।

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WEST BENGAL STATE UNIVERSITY

B.Sc. Programme 6th Semester Examination, 2021

CEMGDSE03T-CHEMISTRY (DSE2)

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.
All symbols are of usual significance.

প্রান্তিক সীমার মধ্যস্থ সংখ্যাটি প্রশ্নের মান নির্দেশ করে।
পরীক্ষার্থীরা নিজের ভাষায় যথাসম্ভব শব্দসীমার মধ্যে উত্তর দিতে হবে। সমস্ত প্রতীক স্বাভাবিক তাৎপর্যপূর্ণ।

Answer any *three* questions taking *one* from each Group
প্রতি Group থেকে *একটি* করে প্রশ্ন নিয়ে মোট *তিনটি* প্রশ্নের উত্তর দাও

GROUP-A
(Unit- 1 & 2)

1. (a) What is flint glass? How does it differ from potash glass? 2
ফ্লিন্ট গ্লাস কি ? পটাশ গ্লাস থেকে এটি কিভাবে আলাদা ?

(b) What is cement? Write the composition of Portland cement. 2+2
সিমেন্ট কি ? পোর্টল্যান্ড সিমেন্টের সংযুতি লেখো।

(c) What is clay? 2
ক্লে কি ?

(d) Name the raw materials used for production of superphosphate. Give chemical reactions involved in this process. 2+2
সুপারফসফেট সার উৎপাদনে কাঁচামালগুলির নাম লেখো। সংশ্লিষ্ট রাসায়নিক বিক্রিয়াগুলি দাও।

(e) What is mixed fertilizer? Which one is a better nitrogenous fertilizer and why: Urea or Ammonium Nitrate? 2+2
মিশ্র সার কি ? কোন্‌টি উন্নত নাইট্রোজেন সার এবং কেন : ইউরিয়া বা অ্যামোনিয়াম নাইট্রেট ?

2. (a) Name the oxides which are used for coloring traffic signal glass. 2
ট্র্যাফিক সিগন্যালের রঙীন কাঁচের জন্য ব্যবহৃত অক্সাইডগুলির নাম দাও।

(b) What is ceramic? Mention its characteristics and uses. 2+2+2
সেরামিক কি ? এর বৈশিষ্ট্য ও ব্যবহার লেখো।

(c) What is the meaning of label 10-20-0 in a bag of fertilizer? 2
একটি সারের ব্যাগে 10-20-0 লেবেলের অর্থ কি ?

(d) What is Biofertilizer? Mention its advantage over chemical fertilizer. 2+2
বায়োফার্টিলাইজার কি ? রাসায়নিক সারের চেয়ে এর সুবিধার কথা উল্লেখ করো।

(e) Write the reactions involved in production of urea. 2
ইউরিয়া উৎপাদনের সাথে জড়িত বিক্রিয়াগুলি লেখো।

GROUP-B
(Unit- 3, 4 & 5)

3. (a) What is paint? Mention the desired properties of an ideal paint. 2+2
রং কি ? একটি আদর্শ রঙের কাঙ্ক্ষিত বৈশিষ্ট্যগুলি উল্লেখ করো।

(b) Write down the main components of oil varnish. 2
তেল বার্নিশের প্রধান উপাদানগুলি লেখো।

(c) With example define Primary and Secondary batteries. 2+2
উদাহরণসহ প্রাইমারী ও সেকেন্ডারি ব্যাটারির সংজ্ঞা দাও।

(d) Write short note on solar cell. 2
সংক্ষিপ্ত টীকা লেখোঃ সোলার সেল।

(e) What do you mean by steel? Mention its properties and uses. 2+2
স্টিল বলতে কি বোঝো ? ইহার বৈশিষ্ট্য ও ব্যবহার উল্লেখ করো।

4. (a) What is enamel? Write the properties of pigment. 2+2
এনামেল কি ? পিগমেন্টের বৈশিষ্ট্যগুলি লেখো।

(b) What is anodizing? 2
অ্যানোডাইজিং কি ?

(c) Write the electrode reactions occurring during charging of a Lead-Acid storage cell. What is the difference between a battery and a fuel cell? Can the "fuel" of a fuel cell be a solid? 2+1+1
লেড-অ্যাসিড স্টোরেজ সেল চার্জ করার সময় ইলেকট্রোড বিক্রিয়াগুলি লেখো। ব্যাটারি এবং জ্বালানী কোষের মধ্যে পার্থক্য কি ? জ্বালানী কোষের ''জ্বালানী'' কি কঠিন হতে পারে ?

(d) What is alloy? Write down two advantages of alloys over metals. 2
অ্যালয় কি ? ধাতু অপেক্ষা অ্যালয়ের দুটি সুবিধা লেখো।

(e) Briefly describe desulphurization process of steel. What are the utilities of this protocol? 2+2
সংক্ষেপে ইস্পাতের ডিসালফারাইজেশন প্রক্রিয়া বর্ণনা করো। এই প্রক্রিয়ার উপযোগিতাগুলি কি কি ?

GROUP-C
(Unit- 6 & 7)

5. (a) What is Phase Transfer Catalysis? Give one example. 1+1
ফেজ ট্রান্সফার ক্যাটালাইসিস কি ? একটা উদাহরণ দাও।

(b) Explain the reason of catalytic activity of zeolite. 2
জিওলাইটের অনুঘটক ক্রিয়াকলাপের কারণ ব্যাখ্যা করো।

(c) What do we mean by Power Index of an explosive? How is it calculated? 1+1
একটি বিস্ফোরকের পাওয়ার ইনডেক্স বলতে কি বোঝো ? এটি কিভাবে গণনা করা হয় ?

(d) How lead azide can be prepared? Give the reaction. 2
লেড অ্যাজাইড কিভাবে প্রস্তুত করা যেতে পারে ? বিক্রিয়া দাও।

6. (a) What are used as rocket propellants? Mention advantage and disadvantage of solid rocket propellants. 1+2
রকেট প্রপেল্যান্ট হিসাবে কি ব্যবহার করা হয় ? কঠিন রকেট প্রপেল্যান্টগুলির সুবিধা এবং অসুবিধা উল্লেখ করো।

(b) What is chemical name of RDX? 1
RDX-এর রাসায়নিক নাম লেখো।

(c) Compare the merits and demerits of Homogenous and Heterogeneous catalysis. 2
সমসত্ব এবং অসমসত্ব অনুঘটকের গুণাবলী এবং ত্রুটিগুলি তুলনা করো।

(d) Finely powdered nickel acts as a better catalyst for hydrogenation of alkene as compared to nickel rods — Explain. 2
সূক্ষ্মভাবে গুঁড়া নিকেল, নিকেল রডের তুলনায় অ্যালকেন হাইড্রোজেনেশনের জন্য একটি ভাল অনুঘটক হিসাবে কাজ করে — ব্যাখ্যা করো।

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WEST BENGAL STATE UNIVERSITY

B.Sc. Programme 6th Semester Examination, 2021

CEMGDSE04T-CHEMISTRY (DSE2)

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.

প্রান্তিক সীমার মধ্যস্থ সংখ্যাটি পূর্ণমান নির্দেশ করে। পরীক্ষার্থীরা নিজের ভাষায় যথা সম্ভব শব্দসীমার মধ্যে উত্তর করিবে।

All symbols are of usual significance.

SECTION-A

Answer *two* questions taking *one* from each Group

প্রতিটি Group থেকে *একটি* করে প্রশ্ন নিয়ে মোট *দুটি* প্রশ্নের উত্তর দাও

GROUP-A / বিভাগ-ক

(Unit- 1 & 2)

1. (a) What are the special characteristics of *d* block elements? 2

'*d*' ব্লক মৌলের বিশেষ বৈশিষ্ট্যগুলি কি ?

(b) What is the oxidation state of Cr in CrO_5? 2

CrO_5-এর মধ্যে Cr-এর জারণস্তর কত ?

(c) How would you prepare $KMnO_4$ from pyrolusite? State with equation one important use of it in analytical chemistry. 3

পাইরোলুসাইট থেকে কিভাবে $KMnO_4$ তৈরী করা যায় ? ব্যবহারিক রসায়নে $KMnO_4$-এর বিক্রিয়াসহ একটি উল্লেখযোগ্য ব্যবহার বলো।

(d) Describe the different binding modes of CO in polynuclear metal carbonyls. 3

পলিনিউক্লিয়ার ধাতব কার্বনেট এর মধ্যে কার্বন-মনোক্সাইডের বিভিন্ন ধরনের বন্ধন সম্পর্কে আলোচনা করো।

2. (a) (i) What do you mean by organometallic compounds? Give example. 2+1

জৈব-ধাতব যৌগ বলতে কি বোঝো ? উদাহরণ দাও।

(ii) "CaC_2 is an organometallic compound" — Justify.

"CaC_2 -একটি জৈব-ধাতব যৌগ" — মন্তব্য করো।

(b) What is EAN rule? Why cobalt and manganese generally form binuclear carbonyls? 4

EAN-নিয়মটি বলো। কোবাল্ট এবং ম্যাঙ্গানিজ সাধারণত বাইনিউক্লিয়ার কার্বনিল যৌগ গঠন করে — কেন ?

(c) Discuss the structure and bonding in Zeise's salt. 3

Zeise's লবণ এর গঠন কাঠামো ও বন্ধন সম্পর্কে আলোচনা করো।

GROUP-B / বিভাগ-খ

(Unit- 3)

3. (a) What are the main sources of sodium and potassium in human life? State the role of Na^+ and K^+ in our body system. 2+3

মানবদেহের প্রয়োজনে সোডিয়াম ও পটাশিয়ামের প্রধান উৎস কি ? Na^+ ও K^+ -এর ভূমিকা কি ?

(b) Explain the importance of copper and iron ions in biological systems. 3

বায়োলজিক্যাল সিস্টেমে কপার, আয়রন আয়নের গুরুত্ব লেখো।

(c) What are the symptoms of low magnesium? 2

ম্যাগনেসিয়াম ধাতুর কম উপস্থিতিতে কি ধরনের অসুবিধা হতে পারে ?

4. (a) Define active and passive transport. What are trace and ultra trace elements? What will be health response if we increase the dose of essential elements? 2+3

সক্রিয় পরিবহন এবং প্যাসিভ পরিবহন এর সংজ্ঞা দাও। ট্রেস এবং আল্ট্রা ট্রেস উপাদান কি ? প্রয়োজনীয় ধাতুর উপাদানগুলির গাঢ়ত্ব বৃদ্ধি পেলে শারীরবৃত্তীয় প্রক্রিয়ায় তার প্রভাব কি হবে ?

(b) Write a brief account on: $2\frac{1}{2}\times2$

(i) Role of Mg^{2+} in photosynthesis.

সালোকসংশ্লেষ প্রক্রিয়াতে Mg^{2+} এর ভূমিকা

(ii) Importance of Ca^{2+} in human life.

মানবজীবনে Ca^{2+} এর গুরুত্ব।

SECTION-B

Answer *two* questions taking *one* from each Group

প্রতিটি Group থেকে *একটি* করে প্রশ্ন নিয়ে মোট *দুটি* প্রশ্নের উত্তর দাও

GROUP-A / বিভাগ-ক

(Unit- 1 & 2)

5. (a) Anthracene undergoes many reactions in 9, 10 positions — Why? 3

অ্যানথ্রাসিনের অনেক বিক্রিয়া উহার 9, 10 চিহ্নিত কার্বন পরমাণুর স্থানে ঘটে থাকে — কেন ?

(b) Arrange the following compounds in increasing order of reactivity towards electrophilic substitution reactions. (With reasons) 3

(i) Furan, (ii) Pyrrole, (iii) Thiophene

নীচের যৌগগুলির ক্ষেত্রে ইলেক্ট্রফিলীয় প্রতিস্থাপন বিক্রিয়ার সক্রিয়তার ক্রম ব্যাখ্যা করো — কারণসহ।

(i) ফিউরান, (ii) পিরোল, (iii) থায়োফিন

(c) How would you prepare ethyl acetoacetate in the laboratory? Why is it called active methylene compound? 3+1

রসায়নাগারে কিভাবে ইথাইল অ্যাসিটোঅ্যাসিটেট প্রস্তুত করবে ? এই যৌগটিকে সক্রিয় মিথিলিন যৌগ বলা হয় কেন ?

6. (a) Compare the basicity of pyridine and pyrrole with reasonable explanation. 2

কারণসহ পিরিডিন ও পিরোলের ক্ষারকত্বের তুলনা করো।

(b) How would you synthesize the following compounds from ethyl acetoacetate? (Any ***two***) 4

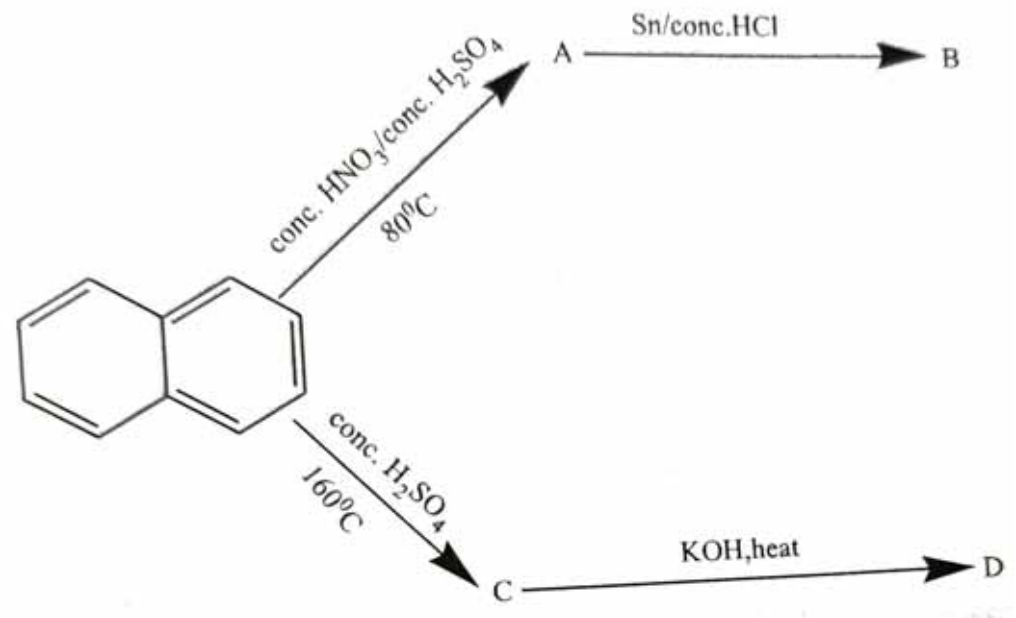
(i) Pentanoic acid, (ii) 2-Butanone, (iii) Chrotonic acid, (iv) Succinic acid

ইথাইল অ্যাসিটোঅ্যাসিটেট থেকে নিম্নলিখিত যৌগগুলি কিভাবে প্রস্তুত করবে ? (যে-কোনো ***দুটি***)

(i) পেন্টানয়িক অ্যাসিড, (ii) 2-বিউটানোন, (iii) ক্রোটোনিক অ্যাসিড, (iv) সাক্সিনিক অ্যাসিড

(c) Identify the product(s) (A, B, C, D): $\frac{1}{2} \times 4 = 2$

নিম্নলিখিত বিক্রিয়াটির জাতক পদার্থ A, B, C ও D শনাক্ত করোঃ



(d) Why generally furan undergoes electrophillic substitution reactions in 2 or 5 positions? 2

সাধারণত ফিউরানের ইলেক্ট্রফিলীয় প্রতিস্থাপন বিক্রিয়া 2 এবং 5 অবস্থানে ঘটে — কেন ?

GROUP-B / বিভাগ-খ

(Unit- 3)

7. (a) How you can separate salicylaldehyde from *p*-hydroxybenzaldehyde by IR spectroscopy? 2

IR স্পেকট্রোস্কপির সাহায্যে স্যালিসাইলডিহাইডকে প্যারা-হাইড্রক্সিবেনজালডিহাইড থেকে কিভাবে পার্থক্য করবে ?

(b) Explain why the stretching frequency of the compounds given below follow this trends: 4

নীচে দেওয়া জৈব যৌগগুলির স্ট্রেচিং কম্পাঙ্কের ক্রম এইরকম হল কেন তার ব্যাখ্যা করো।

RCOCl (1800 cm^{-1}), RCOOR (1760 cm^{-1}), RCOOH (1720 cm^{-1}), $RCONH_2$ (1680 cm^{-1})

(c) Among methane, ethylene and acetylene, which has got highest stretching frequency? — Explain. 2

মিথেন, ইথিলিন, অ্যাসিটিলিন এর মধ্যে কার স্ট্রেচিং কম্পাঙ্ক বেশি ? — ব্যাখ্যা করো।

(d) What is finger print region? 2

ফিঙ্গারপ্রিন্ট অঞ্চল কি ?

8. (a) Define following terms with examples: $1\frac{1}{2}\times2$

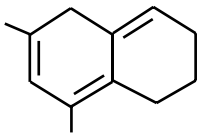
(i) Chromophore (ii) Bathochromic shift

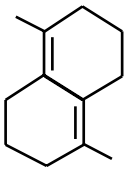
উদাহরণসহ সংজ্ঞা লেখোঃ

(i) ক্রোমোফোর (ii) ব্যাথোক্রোমিক শিফট্

(b) Apply Woodward rules and calculate the value of absorption maxima (λ_{max}) of the following compounds. (any ***one***) 2

উডওয়ার্ড নিয়ম প্রয়োগে নিম্নলিখিত যৌগের λ_{max} নির্ণয় করো। (যে-কোনো ***একটি***)

(i) 

(ii) 

(c) "IR-absorption due to C=C bond occurs at lower frequencies than the C=O bond." — Explain. 3

IR-শোষণ কম্পাঙ্ক (absorption frequencies) C=O বন্ধনের তুলনায় C=C-এর কম হয় — ব্যাখ্যা করো।

(d) *Trans* isomer of stilbene shows λ_{max} at longer wavelength than the *cis* isomer — Explain. 2

স্টিলবিনের ট্রান্স-আইসোমার সিস-আইসোমার এর তুলনায় দীর্ঘতর তরঙ্গদৈর্ঘ্য (λ_{max}) এর অঞ্চলে পরে — ব্যাখ্যা করো।

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within* 1 *hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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WEST BENGAL STATE UNIVERSITY

B.Sc. General Part-I Examination, 2021

CHEMISTRY

PAPER: CEMG-I

Time Allotted: 2 Hours | Full Marks: 50

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

প্রান্তিক সীমার মধ্যস্থ সংখ্যাটি পূর্ণমান নির্দেশ করে। পরীক্ষার্থীরা নিজের ভাষায় যথা সম্ভব শব্দসীমার মধ্যে উত্তর করিবে।

All symbols are of usual significance.

CEMGT-11A

$12\times1 = 12$

Answer any *one* question from either UNIT-I OR UNIT-II

UNIT-I অথবা UNIT-II থেকে যে-কোনো *একটি* প্রশ্নের উত্তর দাও

UNIT-I

1.(a) Mention the assumptions of kinetic theory of gases and derive the equation $PV = \frac{1}{3}mNC^2$, where the symbols have the usual significance. 2+4

গ্যাসের গতিতত্ত্বের স্বীকার্যগুলি উল্লেখ করো এবং $PV = \frac{1}{3}mNC^2$ সমীকরণটি উপপাদন করো, যেখানে ব্যবহৃত চিহ্নগুলি নিজ নিজ বৈশিষ্ট্য নির্দেশ করে।

(b) Define viscosity coefficient of a liquid. Write its unit in CGS systems. Explain that viscosity of a liquid decreases with rise in temperature but that of a gas increases with temperature. 1+1+2

তরলের সান্দ্রতা গুণাঙ্ক কাকে বলে ? CGS পদ্ধতিতে এর একক লেখো। 'উষ্ণতা বৃদ্ধির সঙ্গে তরলের সান্দ্রতা হ্রাস পায় কিন্তু গ্যাসের সান্দ্রতা বৃদ্ধি পায়' – আলোচনা করো।

(c) Calculate the root mean square velocity of oxygen gas at 27°C. 2

27°C উষ্ণতায় অক্সিজেন গ্যাসের গড় দ্বিঘাতীয় গতিবেগের বর্গমূল (RMS velocity) নির্ণয় করো।

2.(a) Prove $\frac{P_C V_C}{RT_C} = \frac{3}{8}$ for a van der Waals gas, where P_C, V_C, T_C are critical pressure, critical volume and critical temperature of the gas respectively. 4

একটি ভ্যান ডার ওয়াল গ্যাসের ক্ষেত্রে প্রমাণ করো $\frac{P_C V_C}{RT_C} = \frac{3}{8}$ যেখানে P_C, V_C, T_C যথাক্রমে ঐ গ্যাসটির সংকট চাপ, সংকট আয়তন ও সংকট তাপমাত্রা নির্দেশ করে।

(b) The van der Waals constants of a gas are a = 6.50 atm lit^2 mole^{-2} and b = 0.056 lit mole^{-1}. Calculate the critical pressure and molar critical volume of the gas. 3

কোন গ্যাসের ভ্যান ডার ওয়াল ধ্রুবকগুলি হল a = 6.50 atm lit^2 mole^{-2} এবং b = 0.056 lit

$mole^{-1}$। গ্যাসটির আণব সংকট আয়তন এবং সংকট চাপ নির্ণয় করো।

(c) Define unit cell of a crystal. Calculate the number of atoms per unit cell of a body centered cubic lattice. What is meant by the plane of symmetry of a crystal? 1+1+1

কোন কেলাসের একক কোষ-এর সংজ্ঞা দাও। একটি দেহকেন্দ্রিক ঘনকের প্রতি একক কোষে পরমাণুর সংখ্যা নির্ণয় করো। কেলাসের প্রতিসাম্য তল বলতে কি বোঝো ?

(d) Surface tension and surface energy are numerically same. — Explain. 2

পৃষ্ঠটান এবং পৃষ্ঠশক্তির সাংখ্যমান সমান– ব্যাখ্যা করো।

UNIT-II

3. (a) Define C_P and C_V. Deduce thermodynamically the equation $C_P - C_V = R$ for one mole of an ideal gas. 2+3

C_P এবং C_V -এর সংজ্ঞা দাও। তাপগতিবিদ্যার সাহায্যে উপপাদন কর যে একটি আদর্শ গ্যাসের এক মোলের জন্য $C_P - C_V = R$ ।

(b) Find out the relation between heat of reaction at constant pressure and that at constant volume for a particular reaction. 3

একটি নির্দিষ্ট বিক্রিয়ার জন্য স্থির চাপে বিক্রিয়া তাপ এবং স্থির আয়তনে বিক্রিয়া তাপের মধ্যে সম্পর্ক স্থাপন করো।

(c) Calculate the maximum work when 2.0 mole of an ideal gas expands isothermally at 27°C from 1 litre to 5 litre. 2

2.0 মোল কোন আদর্শ গ্যাসকে 27°C উষ্ণতায় সমতাপীয়ভাবে 1 লিটার আয়তন থেকে 5 লিটার আয়তনে প্রসারিত করা হলে কৃতকার্যের সর্বোচ্চ পরিমাণ গণনা করো।

(d) State and explain Hess's law of constant heat summation. 2

হেসের তাপ সমষ্টি নিত্যতার সূত্রটি বিবৃত ও ব্যাখ্যা করো।

4. (a) Derive the relation PV^{γ} = constant, for an adiabatic reversible expansion of an ideal gas. 4

আদর্শ গ্যাসের ক্ষেত্রে রুদ্ধতাপীয় পরাবর্ত সম্প্রসারণের জন্য, PV^{γ} = ধ্রুবক উপপাদন করো।

(b) What is inversion temperature? Hydrogen gas on Joule-Thomson expansion at ordinary temperature shows heating effect. — Explain. 2+1

বিলোম উষ্ণতা কি ? সাধারণ উষ্ণতায় হাইড্রোজেন গ্যাসের জুল-থমসন সম্প্রসারণে উষ্ণতা বৃদ্ধি পায়।– ব্যাখ্যা করো।

(c) Calculate the expansion work done when 50 g of water is electrolysed under constant pressure at 25°C. 2

প্রসারণ কার্য নির্ণয় করো, যখন 50 g জলকে তড়িৎ বিশ্লেষিত করা হয় 25°C এবং স্থির চাপে।

(d) The constant pressure heat capacity of a sample of a perfect gas is 20.17 JK^{-1} within the temperature range 25°C to 100°C. Find out the enthalpy change of the gas when the temperature is raised from 25°C to 100°C. 3

একটি আদর্শ গ্যাসের 25°C থেকে 100°C সীমার মধ্যে স্থির চাপে তাপগ্রাহীতা হল 20.17 JK^{-1}। ওই গ্যাসের স্থির চাপে এনথ্যালপির পরিবর্তন নির্ণয় করো যখন তাপমাত্রা 25°C থেকে বাড়িয়ে 100°C করা হল।

CEMGT-11B

13×1= 13

Answer any *one* question from either UNIT-I OR UNIT-II

UNIT-I অথবা UNIT-II থেকে যে-কোনো *একটি* প্রশ্নের উত্তর দাও

UNIT-I

5. (a) Find out the expression for radius of the n^{th} Bohr orbit. Why these orbits are called 'Stationary orbits'? 3+2

n-তম বোর কক্ষের ব্যাসার্ধের রাশিটি নির্ণয় করো। এই কক্ষগুলিকে স্থানুকক্ষ বলা হয় কেন ?

(b) In what ways does an atomic orbital differ from a Bohr's orbit? 3

বোরের কক্ষের সঙ্গে পরমাণু কক্ষকের প্রভেদ কি ?

(c) Deduce an expression for the half-life period of a radioelement. 2

তেজস্ক্রিয় মৌলের অর্ধ আয়ুস্কালের সমীকরণ প্রতিপাদন করো।

(d) Define isobars, isotones with one example. 3

আইসোবার, আইসোটোন-এর একটি করে উদাহরণসহ সংজ্ঞা লেখো।

6. (a) What is Pauli's exclusion principle? What is the electronic configuration of Cu^{2+} ? 2+2

পাউলির অপবর্জন নীতি কি ? Cu^{2+} -এর ইলেকট্রন বিন্যাস লেখো।

(b) How was Bohr's atomic model modified by Somerfield's theory? 2

সোমারফিল্ডের তত্ত্ব কিভাবে বোর পরমাণু মডেল সংশোধিত করে ?

(c) Distinguish between nuclear fission and fusion reactions with suitable examples. 4

উপযুক্ত উদাহরণসহ নিউক্লিয় বিভাজন ও সংযোজন বিক্রিয়াগুলির মধ্যে পার্থক্য নির্দেশ করো।

(d) The half-life of ^{232}Th is 1.4×10^{10} years and that of its daughter element ^{228}Ra is 7 years. What is the weight of ^{228}Ra in equilibrium with 1 gm of ^{232}Th. 3

^{232}Th-এর অর্ধ আয়ুষ্কাল 1.4×10^{10} বৎসর এবং ইহা থেকে উৎপন্ন ^{228}Ra-এর অর্ধ আয়ুষ্কাল 7 বৎসর। কত ভরের ^{228}Ra 1 গ্রাম ^{232}Th -এর সঙ্গে সাম্যাবস্থায় থাকবে ?

UNIT-II

7. (a) Describe the analytical tests to detect the following radicals (with reaction): 2×3

নিম্নলিখিত মূলকগুলির সনাক্তকরণের জন্য গুণগত পরীক্ষা বর্ণনা করো। (বিক্রিয়াসহ)

(i) Fe^{3+} (ii) Cl^{-} (iii) Cu^{2+}

(b) How will you detect $-NO_2$ group in presence of $-NH_2$ group? 2

$-NH_2$ গ্রুপের উপস্থিতিতে কিভাবে $-NO_2$ গ্রুপকে শনাক্ত করবে ?

(c) What is sodium nitropruside test for the detection of S^{2-} ? Write the reactions. 3

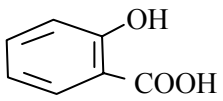
S^{2-} এর সনাক্তকরণে সোডিয়াম নাইট্রোপ্রুসাইড পরীক্ষা কি ? বিক্রিয়াটি লেখো।

(d) What is Brady's reagent? 2

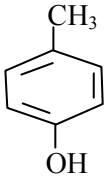
ব্র্যাডির বিকারক কি ?

8. (a) Complete the following reactions: 2×3

নীচের বিক্রিয়াগুলি সম্পূর্ণ করোঃ

(i) 

$+NaHCO_3 \longrightarrow$

(ii) 

$\xrightarrow{FeCl_3}$ (iii) $MnSO_4 + HNO_3 + NaBiO_3 \longrightarrow$

(b) What is the group reagent for Group II and Group IIIA cations? Explain the principle involved in separation of Group IIIA cations. 2+2

গ্রুপ II ও গ্রুপ IIIA ক্যাটায়নগুলির জন্য গ্রুপ বিকারকগুলি কি কি ? গ্রুপ IIIA ক্যাটায়নগুলি পৃথকীকরণের নীতিটি ব্যাখ্যা করো।

(c) Explain the principle of cobalt nitrate test. How does zinc respond to cobalt nitrate test? Write down the pertinent reactions. 3

কোবাল্ট নাইট্রেট পরীক্ষার মূলনীতিটি ব্যাখ্যা করো। জিঙ্ক কিভাবে কোবাল্ট নাইট্রেট পরীক্ষায় সাড়া দেয় ? সংশ্লিষ্ট বিক্রিয়াগুলি লেখো।

CEMGT-11C

12×1 =12

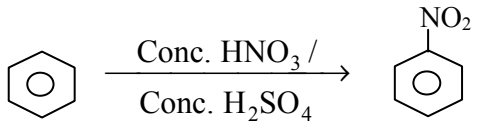
Answer any *one* question from either UNIT-I OR UNIT-II

UNIT-I অথবা UNIT-II থেকে যে-কোনো *একটি* প্রশ্নের উত্তর দাও

UNIT-I

9. (a) Write down the mechanism of the following reaction: 3

নিম্নলিখিত বিক্রিয়াটির ক্রিয়া কৌশলটি বিবৃত করোঃ



(b) A compound *A* gives $(CH_3)_2CO$ and $CH_3CH_2COCH_3$ upon ozonolysis. What is the structure of *A*? 2

একটি যৌগ *A* ওজনোলিসিসের ফলে $(CH_3)_2CO$ এবং $CH_3CH_2COCH_3$ উৎপন্ন করে। *A* যৌগটির গঠন কি ?

(c) What is the product of the following reaction? Give mechanism. 1+2

নিম্নলিখিত বিক্রিয়ায় উৎপন্ন পদার্থটি কি ? বিক্রিয়ার ক্রিয়াকৌশল লেখো।

$$CH_3 - CH = CH_2 \xrightarrow{HBr / H_2O_2}$$

(d) How will you distinguish the compounds chemically in the following pairs? 2+2

নিম্নের জোড়গুলির যৌগগুলিকে কিভাবে রাসায়নিক উপায়ে উহাদের পার্থক্য বোঝাবে ?

(i) $CH_3-CH_2-C\equiv CH$ and $CH_3-C\equiv C-CH_3$

(ii) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH-CH_3$ and $CH_3-CH_2-\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH_2$

10.(a) Write down the canonical forms of *p*-nitrophenoxide ion. 2

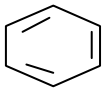
p-নাইট্রোফেনক্সাইড আয়নের সংস্পন্দনজনিত গঠনগুলি লেখো।

(b) Write down the product(s) of the following reactions: 6

নীচের বিক্রিয়াগুলিতে উৎপন্ন পদার্থ(গুলি) লেখোঃ

(i) $CH_3C\equiv CH \xrightarrow[(ii)\,CH_3I]{(i)\,NaNH_2} A \xrightarrow[20\%\ H_2SO_4\,/\,60-80^oC]{1\%\ HgSO_4} B$

(ii) $CF_3CH=CH_2 \xrightarrow{HBr} C$

(iii)  $\xrightarrow[\text{anhd}\ \ AlCl_3]{CH_3CH_2CH_2Cl} D$

(c) Monochlorination of a hydrocarbon (C_5H_{12}) gives only one monochlorinated derivative. Identify the hydrocarbon. 2

একটি হাইড্রোকার্বনের (C_5H_{12}) মোনোক্লোরিনেশনে একটিমাত্র মোনোক্লোরিনেটেড জাতক উৎপন্ন হয়। হাইড্রোকার্বনটি সনাক্ত করো।

(d) Compare the stabilities of $(CH_3)_3\overset{\oplus}{C}$, $CH_3\overset{\oplus}{C}HCH_2CH_3$ with reasons. 2

$(CH_3)_3\overset{\oplus}{C}$ ও $CH_3\overset{\oplus}{C}HCH_2CH_3$ স্থায়িত্ব তুলনা করো। তোমার উত্তরের ব্যাখ্যা দাও।

UNIT-II

11.(a) Write down the Fischer projection formula for 2+2

CH_3 CH(OH) CH(Br) CH_3 and find out R/S configurational descriptors of the stereocentres in the formula you have drawn.

$CH_3CH(OH)$ $CH(Br)CH_3$ যৌগটির ফিশার অভিক্ষেপ চিত্র অঙ্কন করো। তোমার অঙ্কিত চিত্রে উপস্থিত স্টিরিওসেন্টারের R/S নামকরণ করো।

(b) How can you distinguish the following pair by chemical method? $1\frac{1}{2}+1\frac{1}{2}$

রাসায়নিক পদ্ধতিতে কিভাবে নীচের যৌগজোড়গুলির মধ্যে পার্থক্য নিরূপণ করবে ?

(i) $CH_3\,CH_2\,\underset{\displaystyle OH}{\overset{\displaystyle |}{C}}H\,CH_3$ and $(CH_3)_3\,C-OH$.

(ii) $CH_3CH_2OCH_2CH_3$ and $CH_3OCH_2CH_2CH_3$

(c) Give the preparation of phenyl magnesium bromide. Using phenyl magnesium bromide how can you prepare the following compounds. 1+2+2

ফিনাইল ম্যাগনেসিয়াম ব্রোমাইডের প্রস্তুতি লেখো। ফিনাইল ম্যাগনেসিয়াম ব্রোমাইড ব্যবহার করে কিভাবে নিম্নলিখিত যৌগগুলি প্রস্তুত করবে ?

(i) $C_6H_5COCH_3$ (ii) C_6H_5COOH

12.(a) Write down the mechanism of E1 reaction showing the rate determining step. 3

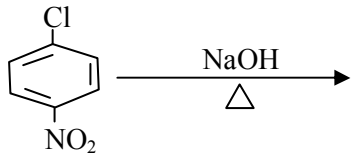
হার নির্ণায়ক ধাপ উল্লেখ করে E1 বিক্রিয়ার ক্রিয়াকৌশল দেখাও।

(b) Write down all the stereoisomers of $CH_3CH(OH)CH(OH)CH_3$. Identify the pair of enantiomers and diastereomers. 3

$CH_3CH(OH)CH(OH)CH_3$ যৌগটির সবকটি স্টিরিওআইসোমার লেখো। এনানশিওমার ও ডায়াস্টিরিওমার জোড়গুলি চিহ্নিত করো।

(c) Predict the products in the following reactions. (any ***two***) 2+2

নীচের বিক্রিয়াগুলিতে উৎপন্ন পদার্থগুলি লেখো। (যে-কোনো ***দুটি***)

(i) 

(ii) $$CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_2-OH \xrightarrow[\Delta]{\text{Conc. } H_2SO_4}$$

(iii) $$CH_3COCH_3 \xrightarrow[\text{(ii) } H_3O^{\oplus}]{\text{(i) } CH_3MgBr}$$

(d) Ethanol is soluble in water but dimethyl ether is not. — Explain. 2

ইথানল জলে দ্রাব্য কিন্তু ডাইমিথাইল ইথার নয়। – ব্যাখ্যা করো।

CEMGT-11D

$13\times1 = 13$

Answer any *one* question from either UNIT-I OR UNIT-II

UNIT-I অথবা UNIT-II থেকে যে-কোনো *একটি* প্রশ্নের উত্তর দাও

UNIT-I

13.(a) What is Lattice energy? Establish the Born-Haber cycle for the formation of Sodium Chloride crystal from Metallic Sodium and gaseous chlorine. 1+4

জালক শক্তির সংজ্ঞা দাও। ধাতব সোডিয়াম ও গ্যাসীয় ক্লোরিন থেকে সোডিয়াম ক্লোরাইড গঠনের 'বর্ণ-হেবার' চক্র প্রতিষ্ঠা করো।

(b) Discuss VSEPR theory and predict the shapes of the following molecules (any ***two***): 2×2

VSEPR তত্ত্ব আলোচনা করো এবং নিম্নলিখিত অনুগুলির আকৃতির আভাস দাও। (যে-কোনো ***দুটি***)

(i) H_2O (ii) SF_6 (iii) NH_3

(c) Explain why 2+2

(i) HF has higher boiling point than HCl.

(ii) PCl_5 is a well known compound but PH_5 does not exist.

কারণ ব্যাখ্যা করোঃ

(i) HF-এর স্ফুটনাংক HCl-এর চেয়ে বেশী।

(ii) PCl_5 অণুটি পাওয়া যায় কিন্তু PH_5 অণুটির অস্তিত্ব নেই।

14.(a) Explain the structures of BCl_3 and PH_3 with the help of theory of hybridisation. 2+2

সংকরায়ণ তত্ত্বের সাহায্যে BCl_3 এবং PH_3-এর গঠন ব্যাখ্যা করো।

(b) Explain: 2+2

(i) NH_3 is more polar than NF_3.

(ii) Melting point of AlF_3 is greater than that of $AlCl_3$.

ব্যাখ্যা করোঃ

(i) NH_3, NF_3 অপেক্ষা বেশী ধ্রুবীয়।

(ii) AlF_3-এর গলনাংক $AlCl_3$ অপেক্ষা বেশী।

(c) $SiCl_4$ hydrolyses readily but CCl_4 is inert towards water. — Explain. 2

$SiCl_4$ সহজে আর্দ্রবিশ্লেষিত হয় কিন্তু CCl_4 জলে নিষ্ক্রিয়।– ব্যাখ্যা করো।

(d) AgF is soluble in water but AgI is not. — Explain. 3

AgF জলে দ্রাব্য কিন্তু AgI নয়। – ব্যাখ্যা করো।

UNIT-II

15.(a) Make a comparative study of N, P and As with respect to the following: 2×3

(i) Hydrides (ii) Oxides (iii) Oxyacids.

N, P এবং As মৌল তিনটির নিম্নোক্ত ধর্মগুলির সাপেক্ষে তুলনামূলক আলোচনা করোঃ

(i) হাইড্রাইড সমূহ (ii) অক্সাইড সমূহ (iii) অক্সিঅ্যাসিড সমূহ

(b) What is electronegativity? Arrange the following with increasing order of electronegativity. Give reasons. 2+2

তড়িৎ ঋণাত্মকতা কি ? নিম্নোক্ত মৌলগুলিকে ক্রমবর্ধমান তড়িৎ ঋণাত্মকতা অনুসারে সাজাওঃ – ব্যাখ্যা করো।

Cl, I, F, Br

(c) Discuss the hydrides of carbon and silicon in a comparative manner. 3

কার্বন ও সিলিকন মৌল দুটির হাইড্রাইড সমূহের মধ্যে তুলনামূলক আলোচনা করো।

16.(a) Compare the Lewis acidity of halides of Boron with proper explanation. 3

উপযুক্ত যুক্তিসহ বোরণ হ্যালাইডগুলির লুইস-এর আম্লিকতার তুলনা করো।

(b) Give one preparation and use of hydrazine. 2

হাইড্রাজিন-এর প্রস্তুতির একটি পদ্ধতি ও ব্যবহার লেখো।

(c) Explain: 2+2

(i) The 1^{st} electron affinity of oxygen is negative but the 2^{nd} electron affinity of oxygen is positive.

(ii) Nitrogen is less electronegative than oxygen but the ionisation potential of nitrogen is greater than that of oxygen.

ব্যাখ্যা করোঃ

(i) অক্সিজেনের প্রথম ইলেকট্রন আসক্তি ঋণাত্মক কিন্তু দ্বিতীয় ইলেকট্রন আসক্তি ধনাত্মক।

(ii) নাইট্রোজেনের তড়িৎ ঋণাত্মকতা অক্সিজেনের থেকে কম কিন্তু আয়নীভবন বিভব অক্সিজেনের চেয়ে বেশী।

(d) Size of K^+ ion is smaller than Cl^- ion although they contain the same number of electrons. — Explain. 2

যদিও K^+ আয়নের এবং Cl^- আয়নে সমসংখ্যক ইলেকট্রন বর্তমান, K^+ আয়নের আকার Cl^- এর থেকে কম। ব্যাখ্যা করো।

(e) Compare the stabilities of $PbCl_2$ and $PbCl_4$ with reasons. 2

কারণসহ $PbCl_2$ ও $PbCl_4$-এর স্থায়ীত্ব তুলনা করো।

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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WEST BENGAL STATE UNIVERSITY

B.Sc. General Part-III Examination, 2021

CHEMISTRY

PAPER: CEMG-IV

Time Allotted: 2 Hours | Full Marks: 50

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

প্রান্তিক সীমার মধ্যস্থ সংখ্যাটি পূর্ণমান নির্দেশ করে। পরীক্ষার্থীরা নিজের ভাষায় যথা সম্ভব শব্দসীমার মধ্যে উত্তর করিবে।

CEMGT-34A

12×2= 24

Answer any *two* questions from the following
নিম্নলিখিত যে-কোনো *দুটি* প্রশ্নের উত্তর দাও

1. (a) What are determinate and indeterminate errors? 2
নির্ণীত ও অনির্ণীত ত্রুটি কি ?

(b) What is standard deviation? Determine the standard deviation for the following numbers: 1+2
0.60, 0.62, 0.55, 0.67, 0.68, 0.72, 0.85
প্রমাণ বিচ্যুতি কি ? নিম্নোক্ত রাশিগুলির প্রমাণ বিচ্যুতি নির্ণয় করো।
0.60, 0.62, 0.55, 0.67, 0.68, 0.72, 0.85

(c) Describe the method of gravimetric estimation of Barium (Principle, Reaction, Procedure, Calculation). 4
তৌলিক পদ্ধতিতে বেরিয়ামের পরিমান নির্ণয়ের পদ্ধতিটি বর্ণনা করো (নীতি, বিক্রিয়া, পদ্ধতি, গণনা)।

(d) What do you mean by 'RAM' and 'ROM'? Give any one difference between 'RAM' and 'ROM'. 2+1
'RAM' ও 'ROM' বলতে কি বোঝো ? 'RAM' ও 'ROM'-এর একটি পার্থক্য লেখো।

2. (a) Discuss the importance of solubility product in chemical analysis with one example. 4
রাসায়নিক বিশ্লেষণে দ্রাব্যতা গুণফলের গুরুত্ব একটি উদাহরণ সহযোগে আলোচনা করো।

(b) Describe a method for gravimetric estimation of Lead (Principle and Reaction). 3
তৌলিক পদ্ধতিতে লেডের পরিমান নির্ণয়ের পদ্ধতিটি বর্ণনা করো (নীতি ও বিক্রিয়া)।

(c) Experimental value of a quantity is 14.75, but its actual value should be 14.70. Calculate 'absolute' error and 'relative' error for this result. 3
একটি রাশির পরীক্ষালব্ধ মান 14.75, কিন্তু ইহার প্রকৃত মান হওয়া উচিত 14.70। এই ফলের জন্য সম্পূর্ণ ত্রুটি ও আপেক্ষিক ত্রুটি গণনা করো।

(d) Add the binary numbers 1101 and 11011. 2
1101 ও 11011 দ্বিক সংখ্যা দুটি যোগ করো।

3. (a) What do you mean by primary and secondary standard solution? Calculate equivalent weight of $KMnO_4$ in acid medium. 2+2

মুখ্য ও গৌণ প্রমাণ দ্রবণ বলতে কি বোঝো ? অম্ল মাধ্যমে $KMnO_4$-এর তুল্যাঙ্কভার নির্ণয় করো।

(b) How is Mg estimated complexometrically? 2

'কম্প্লেক্সোমেট্রিক' পদ্ধতিতে কিভাবে Mg-এর পরিমাণ নির্ণয় করা যায় ?

(c) What is chromatography? Name two adsorbents suitable for use in column chromatography. 2+1

ক্রোমাটোগ্রাফি কি ? কলাম ক্রোমাটোগ্রাফিতে ব্যবহারের উপযোগী দুটি অধিশোষকের নাম লেখো।

(d) In the estimation of Fe^{2+} by $K_2Cr_2O_7$ in acid medium calculate equivalent weight of the primary standard solution showing half reaction. Which indicator is used here? 2+1

$K_2Cr_2O_7$-এর সাহায্যে আম্লিক দ্রবণে Fe^{2+} পরিমাপণে নির্দিষ্ট অর্ধবিক্রিয়া সহ মুখ্য প্রমাণ দ্রবণটির তুল্যাঙ্কভার নির্ণয় করো। এখানে কোন নির্দেশক ব্যবহৃত হয় ?

4. (a) What type of indicator is used in complexometric titration? Explain with example. 3

'কম্প্লেক্সোমেট্রিক' পরিমাপনে কি ধরণের নির্দেশক ব্যবহার করা হয় ? উদাহরণসহ ব্যাখ্যা করো।

(b) Mention the names and functions of constituents of Zimmermann-Reinhardt solution. Write chemical name and formula of Mohr's salt. 2+2

জিমারম্যান-রাইনহার্ড দ্রবণের উপকরণগুলি এবং তাদের উপযোগীতা লেখো। মোর লবণের রাসায়নিক নাম ও সংকেত লেখো।

(c) State the criteria for selection of indicators for acid-base titration. 2

অম্লক্ষারক প্রশমন বিক্রিয়ার সূচক নির্বাচনের নীতি বিবৃত করো।

(d) What is meant by thin layer chromatography? Mention the adsorbent and binder used in its stationary phase. 2+1

থিন্ লেয়ার ক্রোমাটোগ্রাফী কি ? এখানে স্থির দশায় কি ধরণের অধিশোষক এবং বন্ধক ব্যবহার করা হয় ?

CEMGT-34B

$12 \times 1 = 12$

Answer any *one* question from the following

নিম্নলিখিত যে-কোনো *একটি* প্রশ্নের উত্তর দাও

5. (a) What is carbonization of coal? Compare the calorific values of coal gas, producer gas and water gas. 4

কয়লার কার্বনিকরন কি ? কোল গ্যাস, প্রোডিউসার গ্যাস ও ওয়াটার গ্যাসের তাপন মূল্য তুলনা করো।

(b) Name the constituents of LNG and give its calorific value. 2

LNG-এর উপাদানগুলির নাম করো এবং এর তাপন মূল্য দাও।

(c) What is triple superphosphate? Write a short note on Bio-fertilizer. 4

ট্রিপল সুপারফসফেট কি ? জৈব সারের উপর সংক্ষিপ্ত টীকা লেখো।

(d) What is photochromatic glass? Mention its use. 2

ফটোক্রোমাটিক কাঁচ কি ? এর ব্যবহার উল্লেখ করো।

6. (a) Give the outline of production of urea. Which one is a better nitrogenous fertilizer, urea or ammonium sulphate? 4

ইউরিয়া তৈরীর রেখাচিত্র দাও। নাইট্রোজেন ঘটিত সার হিসাবে কোনটি ভালো, ইউরিয়া না অ্যামোনিয়াম সালফেট ?

(b) What do you mean by antiknock compounds? 2
কম্পনরোধী যৌগ বলতে কি বোঝো ?

(c) What is cracking? Explain with a chemical reaction. 4
ভঞ্জন কি ? একটি রাসায়নিক বিক্রিয়ার সাহায্যে ব্যাখ্যা করো।

(d) What is the function of gypsum in cement? 2
সিমেন্টে জিপসামের ভূমিকা কি ?

7. (a) Write down the monomers of Nylon 66 and state one of its uses. 2
নাইলন 66-এর মনোমারগুলি লেখো এবং এর একটি ব্যবহার উল্লেখ করো।

(b) Write short notes on any two: (i) Silicone rubber, (ii) Polythene, (iii) Polyester. 2×2
যে-কোনো দুটির উপর সংক্ষিপ্ত টীকা লেখোঃ (i) Silicone rubber, (ii) Polythene, (iii) Polyester.

(c) How is Metronidazole prepared? State its use. 3
মেট্রোনিডাজোল কিভাবে প্রস্তুত করা হয় ? এর ব্যবহার উল্লেখ করো।

(d) State the functions of pigment in paint. 3
রং এর মধ্যে রঞ্জক-এর কার্য উল্লেখ করো।

8. (a) Give an outline for production of lactic acid from molasses. State its uses. 3
ঝোলাগুড় থেকে ল্যাকটিক অ্যাসিড উৎপাদনের একটি রূপরেখা দাও। ইহার ব্যবহার উল্লেখ করো।

(b) What is vulcanization of rubber? What is its importance? 1+2
রবারের ভালকানাইজেশন কি ? এর গুরুত্ব কি ?

(c) Name one homopolymer and copolymer with their structural configuration. 2
একটি হোমোপলিমার ও কোপলিমার গঠনসহ উল্লেখ করো।

(d) Describe the process of preparation of congo red. 2
কঙ্গোরেড প্রস্তুতি বর্ণনা করো।

(e) Write other names of Vitamin A, B_1, B_2 and B_6. 2
ভিটামিন A, B_1, B_2 ও B_6 এর অপর নাম কি ?

CEMGT-34C

13×1= 13

Answer any *one* question from the following
নিম্নলিখিত যে-কোনো *একটি* প্রশ্নের উত্তর দাও

9. (a) Name two Green House gases. Why are they called so? 1+2
দুটি গ্রিন হাউস গ্যাসের নাম বলো। কেন তাদের এই নাম দেওয়া হয় ?

(b) Distinguish between BOD and COD. 2
BOD ও COD-এর মধ্যে পার্থক্য লেখো।

(c) Write what measures can be taken to prevent soil pollution. 3
ভূমিদূষণ প্রতিরোধের জন্য কি কি ব্যবস্থা নেওয়া যেতে পারে লেখো।

(d) What is PAN? Give its formula. 1+2
PAN কি ? এর সঙ্কেত লেখো।

(e) What are the major layers in atmosphere? 2
বায়ুমণ্ডলের মুখ্যস্তর কি কি ?

10.(a) What are the harmful effects of the gases SO_x and NO_x in the atmosphere? 2+2
বায়ুমণ্ডলে SO_x এবং NO_x গ্যাসগুলির ক্ষতিকর প্রভাবগুলি কি কি ?

(b) Describe the process of waste water treatment. 3
বর্জ্য জল প্রক্রিয়াকরণের পদ্ধতিটি বর্ণনা করো।

(c) Give the harmful effects of lead, mercury and cadmium metals. 3
লেড, মার্কারি ও ক্যাডমিয়াম ধাতুগুলির ক্ষতিকর প্রভাবগুলি উল্লেখ করো।

(d) What is acid rain? 3
অম্লবৃষ্টি কি ?

11.(a) What is meant by rancidity of oil? How can it be prevented? 3
তেলের র‍্যানসিডিটি বলতে কি বোঝো ? ইহা কিভাবে প্রতিরোধ করা যায় ?

(b) Write down the chemical reactions involved in soap production. What is transparent soap? 2+1
সাবান উৎপাদনে সংঘটিত বিক্রিয়াগুলি লেখো। স্বচ্ছ সাবান কি ?

(c) How can you prepare the following? Give their uses. 3+3
নিম্নলিখিতগুলি কিভাবে প্রস্তুত করবে ? এদের ব্যবহার উল্লেখ করো।
(i) Aldrin (ii) Decamethrin.

(d) Give the names of two important emulsifiers. 1
দুটি প্রধান ইমালশনকারকের নাম লেখো।

12.(a) Write the difference between 'Pesticide' and 'Insecticide'. What is I.G.R.? Give one example. 2+2
'Pesticide' ও 'Insecticide'-এর মধ্যে পার্থক্য লেখো। I.G.R. কি ? একটি উদাহরণ দাও।

(b) Give an outline for the large scale production of Vanaspati. 3
বনস্পতি প্রস্তুতের পণ্যোৎপাদন পদ্ধতির রূপরেখা দাও।

(c) Write the difference between oils and fats. What is 'Iodine number' of oils and fats? 3
তেল ও চর্বির পার্থক্য লেখো। তেল ও চর্বির 'আয়োডিন নম্বর' কি ?

(d) Name two food preservatives. State their uses and abuses. 3
দুটি খাদ্য সংরক্ষক পদার্থের নাম লেখো। তাদের ব্যবহার ও অপব্যবহার বিবৃত করো।

Overall Impression-1 mark

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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