WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 6th Semester Examination, 2023

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 in biological systems? Why are they so called? Give names of two essential ultra trace elements.   1+1+1

   (b) Between Hb-O_2 and Hb which one is paramagnetic? "Both O_2 and CO are neutral molecule but CO can destroy the normal activity of Hb" — Comment on it.   2+2

   (c) Define facilitated diffusion in the context of ion transport across biological membrane. Why is the sodium-potassium exchange process described as sodium-potassium pump?   2+2

   (d) Give active site structure of Cytochrome C.   2

   (e) What are the harmful effects of arsenic in human body? Mention the method of removal by Chelation therapy.   3

2. (a) Describe the structure and electron-transport process of 4Fe-4S ferredoxin.   3

   (b) Give the structural features and functions of "blue blood".   2+2

   (c) Mention the toxic effect of lead. How Pb toxicity is removed from body?   3

   (d) Why nature chooses Zn as hydrolytic enzymes but Fe and Cu as e-transfer enzyme in biological system?   3

   (e) What is Wilson's disease? How it can be treated with the help of Chelation therapy?   3

Unit-II

3. (a) Write a general method for the preparation of $Co_2(CO)_8$.   2

   (b) Complete the following reactions: 4

   Ferrocene + HCHO + $(CH_3)_2NH$ $\longrightarrow$? $\xrightarrow{MeI}$?

   Ferrocene + n-C_4H_9Li $\longrightarrow$? $\xrightarrow{N_2O_4}$?

(c) Comment on the CO stretching frequencies (v /cm^{-1}) given below: 4

CO ;	[Ti(CO)$_6$]$^{2-}$;	[V(CO)$_6$]$^{-}$;	Cr(CO)$_6$;	[Mn(CO)$_6$]$^{+}$
2143	1750	1860	2000	2090

(d) Using 18-electron rule, predict the number of metal-metal bonds in the following $1\frac{1}{2}\times2 = 3$ complexes.

     (i) Rh$_6$(CO)$_{16}$ (ii) Ir$_4$(CO)$_{12}$

(e) What is synthetic gasoline? How can it be synthesize using Fischer Tropsch reaction?   3

4. (a) Explain the following aspects of Zeise's salt as evident from various physical measurements: 3

     (i) The length of coordinated olefin C-C bond is greater than the C-C bond in the free hydrocarbon.

     (ii) The Cl trans to ethylene has the large Pt-Cl distance than the other two Pt-Cl distance.

(b) Give reactions of Cp$_2$Fe which are similar and dissimilar to benzene.   3

(c) Suggest a suitable catalyst, show its structure and mechanism for the reaction given below: 5

$$CH_3CH = CH_2 + H_2 \longrightarrow CH_3CH_2CH_3$$

(d) Magnetic moment of the complex ion, [Fe(H$_2$O)$_5$(NO)]$^{2+}$ is 3.9 BM at room temperature. Comment on the oxidation number of iron in this ion.   3

(e) Write a method for acetylation of ferrocene.   2

Unit-III

5. (a) What is trans-influence? How this differs from trans effect? $1\frac{1}{2}+1\frac{1}{2}$

(b) How does nature of solvent affect rate of substitution reaction?   2

(c) Carry out the following reaction by S$_N$2 mechanism: 3

$$[Co(NH_3)_5Cl]^{2+} + OH^- \longrightarrow [Co(NH_3)_5(OH)]^{2+} + Cl^-$$

6. (a) Using Trans effect and bond strength order synthesize the following from K$_2$PtCl$_4$:   3

     (i) Trans isomer of [Pt(NH$_3$)(C$_2$H$_4$)Cl$_2$],

     (ii) Cis isomer of [Pt(NH$_3$)(PPh$_3$)Cl$_2$].

(b) Show the intermediate formed from an octahedral complex taking part in substitution reaction following associative and dissociative mechanism.   3

(c) [Ni(CN)$_4$]$^{2-}$ ion is thermodynamically stable, but kinetically labile. Explain.   2

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WEST BENGAL STATE UNIVERSITY
B.Sc. Honours 6th Semester Examination, 2023

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 and 2)

1. (a) Why the green chemistry is known as sustainable chemistry?   2

    (b) What is the need for derivatisation of a compound? Why unnecessary derivatisation should be avoided?   1+2

    (c) What do you mean by the term inherent safer design? Write the subdivisions of ISD and discuss in brief.   2+3

   (d) Calculate Atom Economy of the following reaction.   2
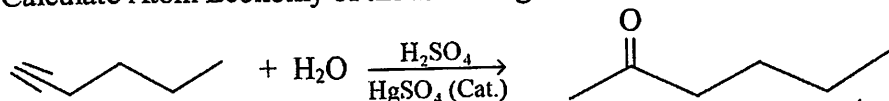
    (e) Which compound was responsible for Bhopal gas tragedy? For which purpose this compound was used?   1+1

    (f) When the following compound A is heated in water at 105°C, it undergoes extensive polymerization. However, heating of A in chloroform-water mixture under microwave irradiation gives α, β-unsaturated ketone in good yield. Explain.   2
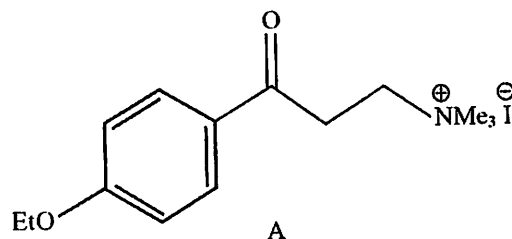
    (g) Sonochemical reactions proceed through radicals. Explain.   2

    (h) Why ionic liquids are called designer solvent? Ionic liquid facilitates transition metal catalyzed reactions — Explain the observation.   2+2

2. (a) Define 'in water', 'on water' and 'with water' reactions. 3

(b) Which of the following methods of synthesizing N,N-dimethyl benzamide is green? Explain your choice. 3
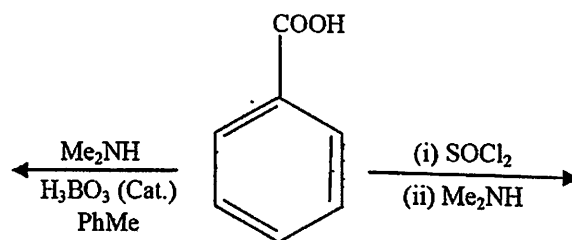
(c) Reaction between cyclopentadiene and methyl vinyl ketone is ~2.5 times more endo selective in water than in ethanol. Explain. 2

(d) What are the differences between atom economy and E-factor? 3

(e) $C_2H_4 + \frac{1}{2}O_2 \longrightarrow C_2H_4O$ (Ethylene oxide). This reaction will take place in the presence of catalyst. Find out the % atom economy. 3

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

(g) Replacement of liquid carbondioxide by halogenated solvent will result in less harm to ground water. Explain the observation. 2

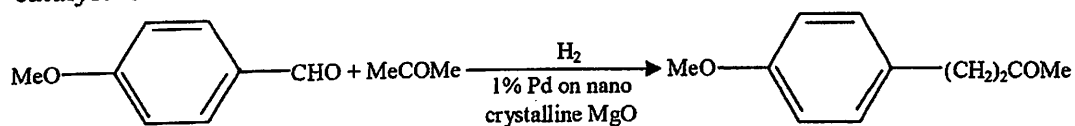(h) Give one example each of biocatalyst, photocatalyst and asymmetric catalyst. 3

GROUP-B

(Unit 3)

3. (a) Mention the enzymes involved in the biological production of adipic acid from glucose. 2×5 = 10

(b) Outline one green and one non-green synthesis of disodium imino diacetate.

(c) Between N,N-dimethyl formamide and toluene which one will you prefer for microwave assisted reactions? Explain your choice.

(d) What happens when anthracene is heated with maleic anhydride in diglyme?

(e) Briefly explain the method for isolation of product from a reaction in supercritical carbon dioxide.

4. (a) What are biopolymers? Discuss the green synthesis of PLA (Poly Lactic Acid) from corn. Why use of PLA in medical implants is safe in human body? 1+2+2

(b) What are healthier fats and oils? 2

(c) What are the main ingredients of commonly used carpets? Mention some disadvantages of PVC backing carpets. 1+2

GROUP-C

(Unit 4)

5. (a) Identify the multifunctional catalyst in the following reaction and explain why the catalyst is called multifunctional?　　　　2

$$MeO\!-\!\!\bigcirc\!\!-\!CHO + MeCOMe \xrightarrow[\substack{1\% \text{ Pd on nano} \\ \text{crystalline MgO}}]{H_2} MeO\!-\!\!\bigcirc\!\!-\!(CH_2)_2COMe$$

(b) What is solvate? Mention the different interactions responsible for the formation of pharmaceutical co-crystals between an active pharmaceutical ingredient and a suitable coformer.　　　　1+2

(c) What are chemoenzymatic reactions? Mention some advantages of chemoenzymatic reactions.　　　　1+2

6. (a) Briefly explain the basic principles of combinatorial green chemistry.　　　　3

(b) Mention one green catalyst for conversion of benzaldehyde into benzoin. Also suggest a plausible mechanism for the reaction.　　　　1+2

(c) Briefly explain a mechanism by which elastin transfers energy.　　　　2

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WEST BENGAL STATE UNIVERSITY
B.Sc. Programme 6th Semester Examination, 2023

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 any *two* questions taking *one* from each Group $10 \times 2 = 20$
প্রতিটি Group থেকে একটি করে প্রশ্ন নিয়ে মোট দুটি প্রশ্নের উত্তর দাও

GROUP-A / বিভাগ-ক

1. (a) What is the oxidation state of Cr in CrO_5?   2
   CrO_5-এর মধ্যে Cr-এর জারণ স্তর কত ?

   (b) Write the two uses of $KMnO_4$.   2
   $KMnO_4$-এর দুটি ব্যবহার লেখো।

   (c) Write the name and structure of the compound formed by the reaction of DMG   2
   with Ni^{2+} ion.
   Ni^{2+}-এর সাথে DMG বিক্রিয়ায় উৎপন্ন যৌগের নাম ও গঠন লেখো।

   (d) What substances are formed when ammonium dichromate is heated?   2
   অ্যামোনিয়াম ডাইক্রোমেটকে উত্তপ্ত করলে কী কী পদার্থ উৎপন্ন হয় ?

   (e) Write the possible oxidation state of Fe and Cr.   2
   Fe ও Cr-এর সম্ভাব্য জারণস্তরগুলি লেখো।

2. (a) What is the 18-electron rule in organometallics? Give an example.   2
   অর্গানোমেটালিক্সে 18-ইলেকট্রন নিয়ম কী ? একটি উদাহরণ দাও।

   (b) Discuss the preparation and structure of Zeise's salt.   4
   Zeise's salt-এর প্রস্তুতি ও গঠন আলোচনা করো।

   (c) Write the reactions of when $Fe_2(CO)_9$ is heated at 50°C.   2
   বিক্রিয়া লেখো; $Fe_2(CO)_9$ কে 50°C তাপমাত্রায় উত্তপ্ত করা হলো।

   (d) Explain the statement; $Mn_2(CO)_{12}$ is diamagnetic.   2
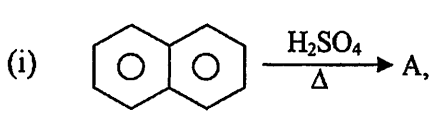 $Mn_2(CO)_{12}$ ডায়াম্যাগনেটিক — উক্তিটি ব্যাখ্যা করো।
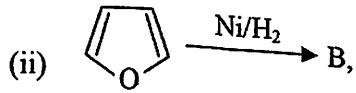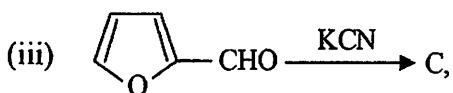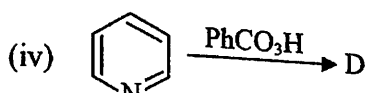
GROUP-B / বিভাগ-খ

3. (a) What is the role of Na^+/K^+ ion pump in biological system?

জৈবিক সিস্টেমে Na^+/K^+ ion পাম্প এর ভূমিকা লেখো।   4

(b) What are the symptoms of low concentration of magnesium?

ম্যাগনেশিয়াম এর কম উপস্থিতিতে কি ধরনের অসুবিধা হয় ?   2

(c) What are trace elements? Give example.

স্বল্পমাত্রিক মৌল বলতে কী বোঝো ? উদাহরণ দাও।   2

(d) Draw the structure of chlorophyll-b.

ক্লোরোফিল-b এর গঠন অংকন করো।   2

4. (a) Write the full form of ATP and ADP.

ATP এবং ADP-এর পূর্ণরূপ লেখো।   2

(b) Write the name of two enzymes containing magnesium.

ম্যাগনেসিয়াম যুক্ত দুটি এনজাইমের নাম লেখো।   2

(c) Write the role of magnesium in chlorophyll.

ক্লোরোফিলে ম্যাগনেশিয়াম এর ভূমিকা লেখো।   2

(d) What are the role of sodium and potassium in biological process?

জৈবিক বিক্রিয়ায় সোডিয়াম ও পটাশিয়াম-এর ভূমিকা লেখো।   2

(e) What do you mean by hypercalcemia and hypocalcemia?

হাইপার ক্যালসেমিয়া ও হাইপো ক্যালসেমিয়া বলতে কী বোঝো ?   2

SECTION-B

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

প্রতিটি Group থেকে *একটি* করে প্রশ্ন নিয়ে মোট *দুটি* প্রশ্নের উত্তর দাও $10×2 = 20$
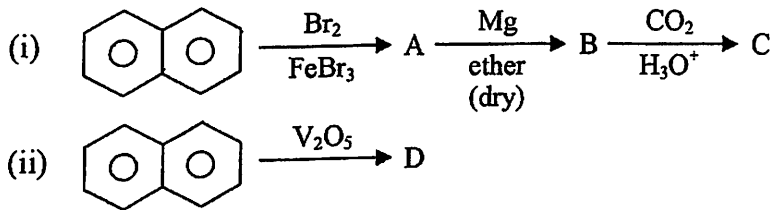
GROUP-A / বিভাগ-ক

5. (a) Complete the following reaction

নীচের বিক্রিয়াগুলি সম্পূর্ণ করো $1×4 = 4$

(b) Explain: Pyridine is more basic than Pyrrole.

ব্যাখ্যা করোঃ পাইরিডিন পাইরোলের চেয়ে বেশি ক্ষারীয়।   2

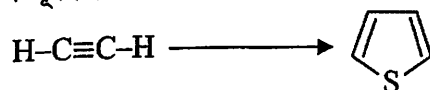(c) Identify A to D $1 \times 4 = 4$

শনাক্ত করো A থেকে D

(i) $\xrightarrow[\text{FeBr}_3]{\text{Br}_2}$ A $\xrightarrow[\substack{\text{ether} \\ \text{(dry)}}]{\text{Mg}}$ B $\xrightarrow[\text{H}_3\text{O}^+]{\text{CO}_2}$ C

(ii) $\xrightarrow{\text{V}_2\text{O}_5}$ D

6. (a) Write the complete reactions of following conversion;   2

নিম্নলিখিত রূপান্তরের সম্পূর্ণ বিক্রিয়া লেখোঃ

$$H-C\equiv C-H \longrightarrow \text{(thiophene ring with S)}$$

(b) Explain with reaction: 6

(i)   The position of Electrophilic substitution in Pyrrole.

(ii) Presence of both the keto and enol forms in Ethyl acetoacetate.

(iii) Electrophilic substitution in pyridine in ordinary temperature is difficult.

বিক্রিয়াসহ ব্যাখ্যা করোঃ

(i)   পাইরোলের ইলেক্ট্রোফিলিক প্রতিস্থাপনের অবস্থান।

(ii) Ethyl acetoacetate-এর keto এবং enol উভয় ফর্মের উপস্থিতি।

(iii) সাধারণ তাপমাত্রায় পিরিডিনে ইলেক্ট্রোফিলিক প্রতিস্থাপন কঠিন।

(c) Write short notes on Sulfonation of naphthalene.   2

ন্যাপথালিন এর সালফোনেশনের উপর সংক্ষিপ্ত টীকা লেখো।

GROUP-B / বিভাগ-খ

7. (a) How can you distinguish between the following pair on the basis of IR   4
spectroscopy?

(i) Salicylaldehyde and *para*-hydroxybenzaldehyde

(ii) *Para*-hydroxybenzoic acid and Salicylic acid.

IR-স্পেকট্রোস্কোপির ভিত্তিতে কীভাবে নিম্নলিখিত জোড়ার মধ্যে পার্থক্য করবে ?

(i) স্যালিসিল অ্যালডিহাইড এবং প্যারা-হাইড্রক্সিবেনজালডিহাইড

(ii) প্যারা-হাইড্রক্সিবেনজয়িক অ্যাসিড এবং স্যালিসিলিক অ্যাসিড।

(b) Write short notes on Bathochromic and Hypsochromic shifts in UV-Vis spectroscopy.   4

সংক্ষিপ্ত টীকা লেখো; Bathochromic and Hypsochromic shifts in UV-Vis spectroscopy.

(c) Explain why; Ethylene does not show IR absorption at 1600 cm^{-1}.   2

ব্যাখ্যা করো; কেন ইথিলিন 1600 cm^{-1} এ IR absorption দেখায় না।

8. (a) Define Fingerprint Region in IR spectra.   2

     IR বর্ণালীতে Fingerprint Region সংজ্ঞায়িত করো।

   (b) Define with two examples for each of **Chromophore** and **Auxochrome**.   4

     Chromophore এবং **Auxochrome**-এর প্রতিটির জন্য দুটি উদাহরণসহ সংজ্ঞায়িত করো।

   (c) Explain why;   4

      (i) λ_{max} of Aniline is 280 nm and that of Anilinium ion is 203 nm.

      (ii) Stretching frequency of 1-Butene is at 1650 cm^{-1} but for Butadiene is at 1600 cm^{-1}.

     ব্যাখ্যা করো কেন ;

      (i) অ্যানিলিনের সর্বোচ্চ λ_{max} = 280 nm এবং অ্যানিলিনিয়াম আয়নের সর্বোচ্চ λ_{max} = 203 nm.

      (ii) 1-Butene-এর স্ট্রেচিং ফ্রিকোয়েন্সি 1650 cm^{-1} কিন্তু Butadiene-এর জন্য 1600 cm^{-1}.

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WEST BENGAL STATE UNIVERSITY
B.Sc. Programme 6th Semester Examination, 2023

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.

প্রান্তিক সীমার মধ্যস্থ সংখ্যাটি প্রশ্নের মান নির্দেশ করে।
পরীক্ষার্থীরা নিজের ভাষায় যথাসম্ভব শব্দসীমার মধ্যে
উত্তর দিতে হবে। সমস্ত প্রতীক স্বাভাবিক তাৎপর্যপূর্ণ।

All symbols are of usual significance.

Answer any *three* questions taking *one* from each Group
প্রতি গ্রুপ থেকে একটি করে প্রশ্ন নিয়ে যে-কোনো *তিনটি* প্রশ্নের উত্তর দাও

GROUP-A
(Unit- 1 & 2)

1. (a) What are the differences between vitrification and glazing? What is Amber glass?   2+2
    ভিট্রিফিকেশন ও গ্লেজিং-এর মধ্যে পার্থক্য লেখো। Amber glass কি ?

    (b) What is biofertilizer? Give two examples of non-nitrogenous fertilizers.   2+2
    বায়োফারর্টিলাইজার কি ? দুটি নাইট্রোজেনবিহীন সারের উদাহরণ দাও।

    (c) What is Glass wool? Write about its uses.   2+2
    গ্লাস উল কি ? ইহার ব্যবহার লেখো।

    (d) What are the basic materials used to manufacture urea? Mention the chemical   2+2
    reactions involved in Urea production.
    ইউরিয়া উৎপাদনের মূল কাঁচামালগুলি কি ? ইউরিয়া উৎপাদনের সংশ্লিষ্ট রাসায়নিক বিক্রিয়াগুলি দাও।

2. (a) What is meant by safety glass and pyrex glass?   2+2
    সেফটি গ্লাস ও পাইরেক্স গ্লাস বলতে কি বোঝায় ?

    (b) What is cement? Mention its utility.   2+2
    সিমেন্ট কি ? এর উপযোগিতা উল্লেখ করো।

    (c) What do you mean by mixed fertilizer? Which one is a better nitrogenous fertilizer and   2+2
    why: Urea or Ammonium Nitrate?
    মিশ্রসার বলতে কি বোঝো ? কোনটি উন্নত নাইট্রোজেন সার এবং কেনঃ ইউরিয়া বা অ্যামোনিয়াম নাইট্রেট ?

    (d) What is enamel? State the use of enamel.   2+2
    এনামেল কি ? এনামেলের ব্যবহার লেখো।

GROUP-B
(Unit- 3, 4 & 5)

3. (a) What do you mean by Chrome Steel? Mention its uses.   2+2
    ক্রোম স্টিল বলতে কি বোঝায় ? এর ব্যবহারগুলি লেখো।

    (b) Write a short note on Eco-friendly paint.   3
    সংক্ষিপ্ত টীকা লেখোঃ পরিবেশ বান্ধব পেইন্ট।

(c) Define "Emulsifier" in paint. Give an example of it.   2+1

উদাহরণসহ পেইন্টে "ইমালসিফায়ার" সংজ্ঞায়িত করো।

(d) Mention the characteristics of batteries.   2

ব্যাটারীর বৈশিষ্ট্য উল্লেখ করো।

(e) What is the function of thinner in paint?   2

রঙে থিনারের (পাতলা কারক) ভূমিকা কি ?

(f) Write short note on solar cell.   2

সংক্ষিপ্ত টীকা লেখোঃ সোলার সেল।

4. (a) Write the electrode reactions occurring during charging of a Lead-Acid storage cell.   3

লেড-অ্যাসিড স্টোরেজ সেল চার্জ করার সময় ইলেকট্রোড বিক্রিয়াগুলি লেখো।

(b) With examples, define primary and secondary batteries.   2+2

উদাহরণসহ সংজ্ঞা দাওঃ প্রাথমিক ও সেকেন্ডারি ব্যাটারী।

(c) What is Alloy? Give two examples.   2+1

অ্যালয় (alloy) কি ? ইহার দুটি উদাহরণ দাও।

(d) What is a surface coating? What are the objectives of surface coating?   2+2

পৃষ্ঠতলের আস্তরণ কি ? পৃষ্ঠতলের আস্তরণের উদ্দেশ্য লেখো।

(e) What is anodizing?   2

অ্যানোডাইজিং কি ?

GROUP-C
(Unit- 6 & 7)

5. (a) Mention the general characteristics of a catalyst.   2

অনুঘটকের সাধারণ বৈশিষ্ট্য উল্লেখ করো।

(b) What is Phase Transfer Catalysis? Give one example.   1+1

ফেজ ট্রান্সফার ক্যাটালিসিস কি ? একটি উদাহরণ দাও।

(c) Explain the reason of catalytic activity of zeolite.   2

জিওলাইটের অনুঘটক ক্রিয়াকলাপের কারণ ব্যাখ্যা করো।

(d) What do you mean by primary and secondary explosives?   2

প্রাইমারি এবং সেকেন্ডারি বিস্ফোরক কাকে বলে ?

6. (a) What do you mean by chemical explosive? Give an example.   2+1

রাসায়নিক বিস্ফোরক বলতে কি বোঝো ? উদাহরণ দাও।

(b) Why is lead azide as explosive? Write down the chemical reaction for lead azide preparation.   2+2

লেড অ্যাজাইড বিস্ফোরক কেন ? লেড অ্যাজাইড প্রস্তুতির রাসায়নিক বিক্রিয়াটি লেখো।

(c) What is the application of negative catalysts in chemistry?   1

রসায়নে ঋণাত্মক অনুঘটকের প্রয়োগ কী ?

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WEST BENGAL STATE UNIVERSITY
B.Sc. Honours 6th Semester Examination, 2023

CEMACOR14T-CHEMISTRY (CC14)

PHYSICAL 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 *three* questions taking *one* from each unit

UNIT-I

1. (a) The first rotational spectral line of CO (C = 12.00, O = 16.00) appears at 3.842 cm^{-1} at 298 K. Explain the effect on the first rotational spectral line if the carbon atom of the molecule is replaced with its higher isotope, that is, $^{13}C^{16}O$.   2

   (b) How many normal modes of vibration are possible for (i) HBr (ii) OCS (linear) (iii) SO_2 (bent)?   1+1+1

   (c) Show that a diatomic molecule dissociates into atoms if it is present in the vibration state of vibrational quantum number (v) 3

   $$v = \frac{1}{2x_e} - \frac{1}{2}$$

   where, x_e is the anharmonicity constant.

   (d) The molecule $^{14}N^{16}O$ when subjected to IR radiation shows absorption at 1876.06 cm^{-1} and 3724.20 cm^{-1} as fundamental and first overtone respectively. Calculate   4

   (i) the equilibrium vibrational frequency.

   (ii) anharmonicity constant.

   (iii) zero-point energy.

   (iv) the position of the first 'hot band'.

   (e) How can you differentiate between $^{\cdot}CH_3$ radical and $^{\cdot}CD_3$ radical using ESR spectroscopy? ($I = \frac{1}{2}$ for H, $I = 1$ for D).   2

2. (a) Which of the following molecule(s) are microwave active? State with reason.   2

   D_2, D_2O, CCl_4, SF_6

   (b) Explain how does the position of the most intense rotational line of HCl change due to   2

   (i) isotopic substitution of H by D

   (ii) decrease of temperature.

1

(c) A linear molecule having the formula AB_2 is suspected to have the structure either BAB or BBA. How can you ascertain the structure to the molecule using its IR and Raman spectra? **3**

(d) The vibrational energy levels of a diatomic molecule are given as **2**

$$\varepsilon_v(cm^{-1}) = 215.02\left(v+\frac{1}{2}\right)\left[1-0.0038\left(v+\frac{1}{2}\right)\right]$$

Find the zero-point energy of the molecule in eV.

(e) The ^{1}H-NMR spectrum of dimethyl nitrosoamine [O=N-N(CH$_3$)$_2$] shows two peaks at low temperature but only one peak at higher temperature ($\sim 200°C$). — Explain. **2**

(f) The Larmor frequency of ^{1}H at 1 tesla (T) is 42.57 MHz. If the magnetogyric ratios for ^{1}H and ^{13}C are 26.75×10^7 rad.T^{-1}.s^{-1} and 6.72×10^7 rad.T^{-1}.s^{-1}, respectively. What is the Larmor frequency of ^{13}C, in MHz at 1 tesla? **3**

UNIT-II

3. (a) What do you mean by photostationary state? How is it different from a chemical equilibrium? **2**

(b) The mechanism for photochemical decomposition of HI may be outlined as follows **2+1**

HI + hν ⟶ H + I

H + HI ⟶ H$_2$ + I (rate constant k_2)

I + I ⟶ I$_2$ (rate constant k_3)
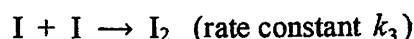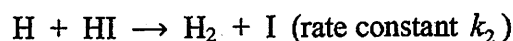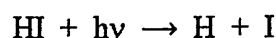
Show that the quantum efficiency with respect to decomposition of HI is equal to 2. Is a quantum efficiency greater than unity acceptable? Justify your answer.

(c) Define molar absorptivity. Is it an intensive property? On what factors does it depend? **3**

(d) A dye solution of concentration 0.74 mgL^{-1} absorbs 40% of radiation of wavelength 610 nm in a cell of thickness 1 cm. Calculate (i) the molar mass of the dye compound, (ii) the energy of one einstein in the incident radiation in S.I. unit. (Given: $\varepsilon = 9.6 \times 10^4$ M^{-1}cm^{-1}) **2+2**

4. (a) State and explain Franck-Condon principle. **2**

(b) Dimerization of Anthracene attains photostationary state. The plausible mechanism of the dianthracene formation is **3**

$$A + h\nu \longrightarrow A^* \qquad Rate = I_a$$
$$A^* + A \xrightarrow{k_2} A_2 \qquad k_2 \text{ is rate constant}$$
$$A^* \xrightarrow{k_3} A + h\nu' \qquad k_3 \text{ is rate constant}$$
$$A_2 \xrightarrow{k_4} 2A \qquad k_4 \text{ is rate constant}$$

where, A is Anthracene monomer and A_2 is dianthracene and A^* is photoexcited state of Anthracene. Show that at very high concentration of Anthracene monomer, the concentration of dianthracene is independent of monomer concentration.

(c) The quantum yield for the photodissociation of ICN(g) into I(g) and CN(g) by a 306 nm pump pulse is 1.00. If the radiant energy of the pump pulse is 1.55×10^{-4} J, determine the number of CN(g) radicals created per pulse if only 0.100% of the incident light is absorbed by the ICN(g) sample. **3**

(d) Compare and contrast (with suitable reasoning) between fluorescence and phosphorescence with reference to the following points: 4

(i) wavelength, (ii) intensity, (iii) radiative lifetime, (iv) temperature at which they are usually observed.

UNIT-III

5. (a) Show that the surface tension and surface energy of a liquid are numerically equal. 2

(b) Show that the work of adhesion between two immiscible liquid phases α and β is given as 3

$$w_A^{\alpha\beta} = \frac{1}{2}(w_C^\alpha + w_C^\beta) - \gamma^{\alpha\beta}$$

where, w_C^α and w_C^β denote the work of cohesion for phases α and β, respectively, and $\gamma^{\alpha\beta}$ denotes the interfacial tension between the two phases. Hence comment on the condition for miscibility of the two liquid phases.

(c) The adsorption of a gas on a solid surface obeys the Langmuir isotherm with $K = 0.78$ kPa^{-1} at 30°C. Calculate the pressure at which the fractional surface coverage is (i) 20%, and (ii) 80%. Provide a physical justification of your result (variation of fractional surface coverage with pressure). 3

(d) What is 'Zeta potential'? Explain the stability of lyophobic colloids with the help of zeta potential. 1+2

(e) State and explain Schulze-Hardy rule. 1+2

6. (a) Derive Laplace equation for excess pressure inside a spherical bubble suspended in air. 3

(b) Adsorption of CO on charcoal at 273 K follows Langmuir isotherm. A plot of P (kPa) / V (cm^3) versus P (kPa) is linear with a slope of 0.01 and y-intercept of 0.5. What is the equilibrium constant, K in (kPa^{-1}) for the adsorption? 3

(c) Find the energy required in breaking 1 mL of water into small droplets having an average radius of 10^{-5} cm. The surface tension of water is 72 dyn cm^{-1} at 298 K. 3

(d) The surface tension (γ) of a liquid is found to vary according to the following relationship due to adsorption of a solute 3

$$\frac{\gamma}{\gamma^0} = 1 - \beta \ln\left(1 + \frac{c}{\alpha}\right)$$

where, γ^0 is the surface tension of the pure liquid, c is the concentration of the solute, α, β are constants. Using Gibbs adsorption isotherm show that

$$\Gamma = \frac{\beta\gamma^0}{RT}\left(\frac{\frac{c}{\alpha}}{1+\frac{c}{\alpha}}\right)$$

(e) What is Critical Micelle Concentration (CMC)? What is the effect of temperature on CMC? 1+1

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WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 6th Semester Examination, 2023

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.
All symbols are of usual significance.

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

GROUP-A

(Unit 1 and 2)

1. (a) What is cement? Write down the composition of Portland cement.   1+2

   (b) What is the general composition of glass? Give a flow diagram of the manufacturing process of glass.   1+3

   (c) Why annealing of glass is essential?   2

   (d) What is feldspar? Write one of its use.   2

   (e) Distinguish between Vitrification and Glazing of Ceramics.   3

2. (a) Write a short note on C_{60} fullerene.   3

   (b) Describe what do you understand by high technology ceramics and mention one of its use.   2+1

   (c) What is superphosphate of lime?   2

   (d) What do you mean by mixed fertilizer? Cite one example.   2+1

   (e) Write down the probable reactions responsible for setting of cement.   3

GROUP-B

(Unit 3, 4 and 5)

3. (a) What are pigments? State the functions of pigments in a paint.   3

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

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

   (d) Write a short note on the heat treatment of steels.   3

   (e) What are electrolytic and electroless coatings?   3

4. (a) State the components of a lithium-ion battery. Write the anodic and cathodic reactions involved in a lithium-ion battery. 2+2

(b) How will you classify steels based on their carbon content? 3

(c) Briefly describe the process of dephosphorisation during manufacture of steel. 2

(d) How are the fuel cells classified? Write an example for each. 2+2

(e) What is surface treatment for alloys? 3

GROUP-C
(Unit 6 and 7)

5. (a) How is PETN prepared? Write down the decomposition reaction of PETN. 2+1

(b) What is meant by regeneration of catalyst? 2

(c) What are Zeolites? Give two examples. 3

(d) What is Phase transfer catalyst? 2

6. (a) Write a short note on rocket propellants. 3

(b) What are explosives? What are the basic requirements of chemical explosives? 3

(c) What is homogeneous catalyst? Cite one example. 2

(d) How is RDX prepared? 2

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WEST BENGAL STATE UNIVERSITY

B.Sc. Programme 6th Semester Examination, 2023

CMSGDSE03T-COMPUTER SCIENCE (DSE2)

SOFTWARE ENGINEERING

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.

GROUP-A

1. Answer any *five* questions from the following: 2×5 = 10
   (a) How software reverse engineering works?
   (b) Discuss the significance of requirement engineering.
   (c) What are the major advantages of constructing a working prototype before starting to develop the actual software?
   (d) What are the characteristics of a Good SRS Document?
   (e) What is unit testing?
   (f) List any four types of Black box testing.
   (g) "If we increase the cohesion of a design, coupling in the design would automatically decrease." Justify your answer.
   (h) Why is it important to test boundary values while testing a function?

GROUP-B

Answer any *five* questions from this group   8×5 = 40

2. Describe different phases of incremental model in brief. What are its disadvantages?   5+3

3. What are the tasks performed in requirement engineering? Discuss the components of a Software Requirement Specification document.   4+4

4. What do you mean by architectural design of Software Engineering? Discuss its different types briefly.   3+5

5. Describe different steps required to schedule the project activities. Define Gantt Chart.   5+3

6. What do you mean by Cyclomatic complexity? Explain with an example. What do you mean by integration testing?   2+4+2

7. (a) Describe the differences between the black-box and white-box testing.   4+(2+2)
   (b) Define exhaustive testing and test case.

8. (a) Why quality of a software is important?   2+6
   (b) Describe the McCall's quality model.

9. Write short note on the following (any *two*):   4+4
   (a) Structural testing
   (b) Data Flow-based testing
   (c) Regression testing.

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