

S-6/CEMH/07/17

**TDP (Honours) 6th Semester
Exam., 2017**

CHEMISTRY

(Honours)

SEVENTH PAPER

Full Marks : 80

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

GROUP—A

(Physical Chemistry)

(Marks : 40)

Answer two questions from each Unit

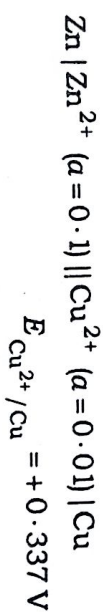
UNIT—I

1. (a) Derive the expression for e.m.f. of electrolytic concentration cells without transference.
- (b) Mention any two applications of e.m.f. measurement (no discussion is required).

(2)

(c) Write the important factors which are responsible for corrosion of cell.

(d) Calculate the potential of the following cell at 298 K :



$$4+2+2+2=10$$

2. (a) Distinguish between physical and chemical adsorptions.

(b) Discuss the behaviours of Langmuir isotherm at very high and very low pressures.

(c) What do you mean by zeta potential?

(d) Arrange the following in increasing order of flocculation value for a negative solution :



Comment on your answer.

(e) Give one example of enzyme catalysis reaction.
 $2+3+2+2+1=10$

3. (a) Discuss Beer's law. What is the significance of molar extinction coefficient?

M7/836

(Continued)

(3)

(b) What do you mean by isotactic and syndiotactic polymers?

(c) "All polymers are macromolecules but all macromolecules are not polymers." Justify the statement.

(d) A 0.003 M solution of a coloured substance transmits 75% of the incident light of 500 nm when in a cell of length 1 cm. Calculate the extinction coefficient.
 $3+2+2+3=10$

UNIT—II

4. (a) Explain the origin of Stokes and anti-Stokes lines in Raman scattering.

(b) State Born-Oppenheimer approximation. Write the form of the total wave function of a molecule in the light of it. (No explicit expression is needed.)

(c) State Franck-Condon principle. Explain it with the help of a diagram.
 $3+(1\frac{1}{2}+2)+(1\frac{1}{2}+2)=10$

5. (a) Write down the Schrödinger time-independent equation in full form. What is its importance?

M7/836

(Turn Over)

(4)

(b) Discuss the criteria for the formation of molecular orbital from atomic orbital.

(c) For photoelectric effect, the threshold wavelength of certain metal is 450 nm. A light of wavelength 350 nm was allowed to fall on the metal. Calculate the kinetic energy of the ejected electron and also the de Broglie wavelength of the electron.
 $3+3+4=10$

6. (a) Discuss the difference between the approaches of the classical thermodynamics and the statistical thermodynamics.

(b) Derive Boltzmann distribution law (much algebraic exercise may be avoided).

(c) Consider a system of six identical but distinguishable particles. One of the macrostates has the following arrangement of the particles :

Energy	0e	1e	2e	3e	4e
No. of particles	0	0	2	2	2

Calculate its thermodynamic probability.
 $3+5+2=10$

M7/836

(Continued)

(5)

GROUP—B

(Industrial and Green Chemistry)

(Marks : 40)

Answer any four questions

7. (a) What do you mean by setting of cement?

(b) What is nitrogen fixation by plant?

(c) Write notes on the following :

(i) Optical glass

(ii) Devitrification of glass $3+3+4=10$

8. (a) What do you mean by alloy? Why do the transition metals give number of alloys?

(b) What is the difference between roasting and calcination?

(c) Write notes on the following :

(i) Radioactive hazards

(ii) Effect of Pb poisoning $3+3+4=10$

9. Write notes on the following industrial processes (any two) : $5 \times 2 = 10$

(a) Fisher-Tropsch process

(b) Hydrogenation of vegetable oil

(c) Fermentation of starch and sugar

M7/836

(Turn Over)

10. (a) What is green chemistry? State the principles of green chemistry.
- (b) What are green solvents? What are their characteristics? $(1+6)+(1\frac{1}{2}+1\frac{1}{2})=10$
11. (a) Explain clearly, what is meant by 'environmental E-factor' for wastes in chemical processes.
- (b) Compare the production of acetanilide using conventional and green methods. Which principle of green chemistry does it follow?
- (c) "Prevention of waste is better than to clean up after production." Justify this statement in the light of green chemistry. $2+(4+1)+3=10$
12. (a) What do you mean by solvent-free reaction? What are the significances of this type of reaction for sustainable development?
- (b) Define the term 'atom economy'. Which one of the following reactions has the highest atom economy? Explain with suitable examples :
- (i) Dehydration reaction
- (ii) Cycloaddition reaction $(2+2)+(2+2+2)=10$

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S-6/CEMH/07/19

TDP (Honours) 6th Semester Exam., 2019

CHEMISTRY

(Honours)

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GROUP—A

(Physical Chemistry)

(Marks : 40)

Answer two questions from each Unit

UNIT—I

1. (a) What is overvoltage? Write Tafel equation to show the effect of change in current density on overvoltage.
- (b) Construct a chemical cell without transference and derive an expression of E_{cell} for it.

(2)

- (c) Calculate the equilibrium constant for the following reaction at 25 °C :



Given

$$E_{\text{Zn}^{2+}, \text{Zn}}^{\circ} = -0.761 \text{ V}$$

$$E_{\text{Fe}^{3+}, \text{Fe}^{2+}}^{\circ} = 0.771 \text{ V}$$

$$(1+2)+(1+3)+3=10$$

2. (a) How does the adsorption theory describe the catalytic functions in heterogeneous catalysis?

(b) What are associated colloids? Define the critical micelle concentration and its application.

(c) Write the limitations of Freundlich adsorption isotherm.

(d) Define quantum yield. $3+(1+1)+2+2=10$

3. (a) What do you mean by molecular weight distribution? Mention the structural information we get from molecular weight distribution.

(b) Discuss in brief the theory for determination of molar mass of a polymer by the measurement of osmotic pressure. What type of average molar mass is determined by this method?

M9/730

(Continued)

(3)

- (c) A substance in aqueous solution at a concentration 10^{-3} M absorbs 10% of incident light in a path length 1 cm. What concentration will be required to absorb 90% of the light? $(2+1)+(3+1)+3=10$

UNIT—II

4. (a) Explain the origin of Stokes and anti-Stokes lines in Raman scattering.

(b) State the Franck-Condon principle. Explain it with an appropriate diagram. What is vertical transition?

(c) A Raman active sample is excited with the incident radiations of the wavelength 1075 nm. A sharp line appears at 8920 cm^{-1} .

(i) Calculate the position of the Rayleigh line in cm^{-1} .

(ii) Find out the Raman shift and comment whether the Raman line is a Stokes line or an anti-Stokes line. $4+3+3=10$

5. (a) What do you understand by eigenfunctions and eigenvalues? Is the Schrödinger equation an eigenvalue equation? Explain.

M9/730

(Turn Over)

(4)

(b) Construct sp-hybrid orbitals by combining one 2s and one 2p atomic orbitals.

(c) Calculate the de Broglie wavelength of an electron that has been accelerated through a potential difference of 300 volts.
(1+1+2)+3+3=10

6. (a) Assuming Boltzmann distribution formula, show that the internal energy (U) of a system is

$$U = NKT^2 \left[\frac{\partial \ln Q}{\partial T} \right]_V$$

where, the terms have their usual meanings.

(b) Derive Sackur-Tetrode equation.

(c) Calculate the translational partition function for 2 moles of O_2 at 5 atmospheric pressure at 25 °C, assuming the gas to behave ideally.

$$3+4+3=10$$

M9/730

(Continued)

(5)

GROUP—B

(Industrial and Green Chemistry)

(Marks : 40)

Answer any **four** questions

7. (a) What is cracking? Write the advantages of catalytic cracking over thermal cracking. Describe the process of catalytic cracking of petroleum.

(b) Write down the composition and calorific values of coal gas and water gas. Why is water gas called blue gas?

$$(1+2+3)+(3+1)=10$$

8. (a) Name two edible and two non-edible oils of vegetable origin. Why is unsaturated oil made saturated?

(b) Write down the chemical reaction involved in production of soap. What is liquid soap? Mention the advantages of its use. Give an example of an enzyme-based detergent.

(c) Name two important by-products of sugar industry.
(2+2)+(1+1+1+1)+2=10

M9/730

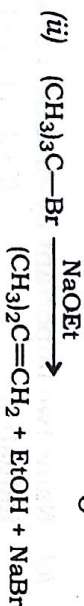
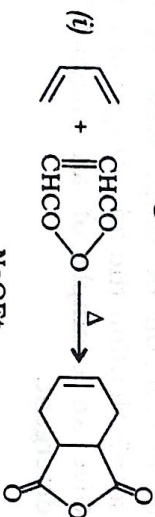
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9. (a) Describe the process of nitrogen fixation by plants.
- (b) What is superphosphate of lime? What do you mean by NPK-type fertilizers?
- (c) Write brief notes on the following :
- (i) Biodiesel
- (ii) Synthetic petrol $3 + (1\frac{1}{2} + 1\frac{1}{2}) + (2 \times 2) = 10$

10. (a) How will you obtain benzoin by green synthesis? Write the mechanism of the reaction.

- (b) Give one example (chemical reaction) for each of the following :
- (i) Ultrasound assisted reaction
- (ii) Microwave assisted reaction in solid phase
- (iii) Ionic liquid catalyzed reaction
 $(2+2) + (2 \times 3) = 10$

11. (a) Calculate the percentage atom economy of the following reactions :



Which one of the above reactions is green reaction and why?

M9/730

(Continued)

- (b) Suggest a green method of synthesis of dihydropyrimidinose. Write down the mechanism of the reaction.
- (c) Name one green brominating reagent used for the preparation of bromo derivative of acetanilide. Why is it green?
 $(3+2) + 3 + 2 = 10$

12. (a) What are green solvents? Give example.
- (b) Carry out the following conversions in green way and give the possible mechanism :
- (i) $\text{Ph}_2\text{CO} \rightarrow \text{Ph}_2\text{C}(\text{OH})-\text{COOH}$
- (ii) $\text{PhNH}_2 \rightarrow \text{PhNHCOCH}_3$
- (c) Give two examples of green oxidizing agents.
 $(2+1) + (3+3) + 1 = 10$

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S-6/CEMH/07/19

TDP (Honours) 6th Semester Exam., 2020CHEMISTRY
(Honours)

SEVENTH PAPER

Full Marks : 80

Time : 3 hours

*The figures in the margin indicate full marks
for the questions**Write the answers of each Group in a separate book*

GROUP—A

(Physical Chemistry)

(Marks : 40)

Answer **two** questions from each Unit

UNIT—I

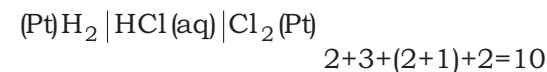
1. (a) Distinguish between electrolytic and electrochemical cells.
- (b) Derive the expression for the determination of e.m.f. of a lead accumulator cell.

- (c) What is liquid junction potential? How could it be eliminated?

- (d) The reaction



has an equilibrium constant $K = 10^{46}$ at 25 °C. Calculate E° at 25 °C for the cell



2. (a) What are the assumptions proposed to obtain Langmuir adsorption isotherm?
 - (b) State and explain Beer-Lambert law.
 - (c) What are electrical double layer and zeta potential?
 - (d) What is the effect of temperature on enzyme catalysis? 2+3+(1½+1½)+2=10
3. (a) What do you mean by 'degree of polymerization' of a polymer?
 - (b) What is intrinsic viscosity? How is it used to determine the molecular weight of macromolecules?
 - (c) What is meant by conformation and configuration of macromolecules in solution?

(3)

- (d) Calculate the energy produced per mole of photons having wavelength of 2000 Å.
 $2+(1+3)+2+2=10$

UNIT—II

4. (a) Write down the expression for rotational energy levels in joules and in cm^{-1} allowed for a rigid diatomic molecule.
- (b) Explain the Born-Oppenheimer approximation.
- (c) What is Raman effect? How does Raman scattering differ from Rayleigh scattering?
- (d) In the IR spectrum of CO, there is an intense band at 2168 cm^{-1} . Calculate—
- (i) the fundamental vibration frequency;
- (ii) the force constant. $2+2+2+(1+3)=10$
5. (a) How did the concept of Heisenberg lead to the development of quantum mechanics?
- (b) Mention the conditions to be satisfied by the wave function to have a physical significance.

(4)

- (c) What is 'Walsh diagram'?
- (d) Write the electronic configuration of CO and NO. $3+3+2+2=10$
6. (a) What do you mean by canonical and microcanonical ensemble?
- (b) What do you mean by thermodynamic probability? Show that $S = k \ln W$.
- (c) What is partition function?
- (d) Calculate the number of ways of arranging 5 quantas among 3 energy levels, such that one has one quanta and two have 2 quanta respectively.
 $2+(1+3)+1+3=10$

GROUP—B

(Industrial and Green Chemistry)

(Marks : 40)

Answer any **four** questions

7. (a) What is glass? What are the raw materials used for the production of glass? Give an approximate composition of flint glass.
- (b) Name two lead and zinc containing paints and mention their colour. What is the role of binder and solvent in paints?

(5)

- (c) Name the enzymes that convert starch into ethyl alcohol. Write the reactions for the process. $3+4+3=10$
8. (a) What is the composition of Portland cement? Why is gypsum added to clinker before grinding?
- (b) Write short notes on the following :
- (i) Cellulose
 - (ii) Synthetic rubber $4+(3+3)=10$
9. (a) Write the composition and uses of the following alloys :
- (i) Duralumin
 - (ii) Monel
- (b) Name the diseases caused due to lead and mercury metal poisoning. Mention the antidotes used for recovery.
- (c) What do you mean by corrosion? How can it be prevented? $(2+2)+(2+2)+2=10$
10. (a) Define green chemistry. State four principles of green chemistry.
- (b) What are green oxidizing agents? Give one example.
- (c) Mention the different types of energy source used in green reactions. $(2+4)+2+2=10$

(6)

11. (a) "Maximizing the incorporation of all the reactants used in the process in the product by designing a suitable synthetic method." Justify the statement in the light of green chemistry.
- (b) Give two applications of the following green reagents :
- (i) Liq. CO_2
 - (ii) Ionic liquids
- (c) What is sonochemical reaction? $4+(2+2)+2=10$
12. (a) Carry out the following conversions in green way and give the possible mechanism :
- (i) *p*-Anisaldehyde Ethyl-2-cyano-3-(4-methoxyphenyl) propenoate
 - (ii) Acetanilide *p*-Bromoacetanilide
- (b) Explain why microwave assisted organic syntheses are considered green. Give two examples of MW assisted reaction. $(3+3)+(2+2)=10$

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