**2017-18**  
M.Sc. (I SEMESTER) EXAMINATION  
(POLYMER SCIENCE & TECHNOLOGY)  
PHYSICAL CHEMISTRY-I  
(AC-1511)  
Maximum Marks: 60  
Credits: 04  
Duration: Two Hours

**Answer all the questions.**

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Questions</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Explain ANY TWO of the following:</td>
<td>[2×2]</td>
</tr>
<tr>
<td></td>
<td>(i) Adiabatic and isobaric processes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) Intensive and extensive properties</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii) Second law of thermodynamics</td>
<td></td>
</tr>
</tbody>
</table>

**OR**

<table>
<thead>
<tr>
<th>1(a’)</th>
<th>Describe the applications of Clausius-Clapeyron equation for liquid-vapour equilibrium.</th>
<th>[4]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(b)</td>
<td>Calculate the molar heat of vaporization of water between 95 and 100 °C, if vapour pressures of water at 95 and 100 °C are 634 and 760 mm of Hg, respectively.</td>
<td>[3]</td>
</tr>
<tr>
<td>1(c)</td>
<td>Discuss the first law of thermodynamics. Write the mathematical formulation of first law of thermodynamics for an adiabatic process.</td>
<td>[4]</td>
</tr>
<tr>
<td>1(d)</td>
<td>In an experiment 400 kJ heat is absorbed by the system so that its internal energy increases by 250 kJ. How would you apply the law of conservation of energy to this system?</td>
<td>[4]</td>
</tr>
<tr>
<td>2(a)</td>
<td>Explain the Lindemann’s theory of unimolecular reactions. Prove that unimolecular reactions follow first order kinetics at high pressure while second order kinetics at low pressure.</td>
<td>[6]</td>
</tr>
</tbody>
</table>

**OR**

<table>
<thead>
<tr>
<th>2(a’)</th>
<th>Discuss ‘activation complex theory’ of reaction rate.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2(b)</td>
<td>Explain the Arrhenius equation. The activation energies of catalysed and non-catalysed reactions at 37 °C are 25.10 and 83.68 kJ/mol, respectively. Calculate the ratio of the rate constants of the catalysed and non-catalysed reactions. Assume that Arrhenius pre-exponential is same for both cases (Given: R = 8.314 J/K/mol).</td>
<td>[5]</td>
</tr>
</tbody>
</table>
2(c) Discuss the half-life method for the determination of order of reaction. [4]

3(a) Draw and discuss the phase diagram of carbon dioxide. [7]

3(b) What are the eutectic and eutectoid points? Explain the eutectic point in Pb-Ag system. [4]

3(c) Derive the mathematical relation between $K_e$ and $K_p$. [4]

OR

3(c') Write the characteristics of equilibrium constant.

4(a) State and Explain Debye-Huckel theory of ion-ion interaction. [5]

4(b) Explain Debye-Huckel law of activity coefficients. [5]

4(c) Explain **ANY TWO** of the following: [2×2.5]

(i) Equivalent conductivity
(ii) Exchange current density
(iii) Kohlrauch’s law

OR

4(c') Calculate the molar conductance at infinite dilution for CH$_3$CICOOH, if the molar conductances at infinite dilution for HCl, KCl and CH$_3$CICOOK are 426.2, 149.9 and 113.2 S cm$^{-2}$ mol$^{-1}$, respectively. [5]
Answer all the questions.

1(a) Define aromaticity. Give the structural requirements to be met by an organic compound or ion to show aromaticity. Discuss the nature of cyclo-1,3,5,7-octatetraene in the light of the structural requirements for aromaticity. [1+2+2]

1(b) Why halogens are ortho- and para-directing but deactivating to benzene ring towards electrophilic substitution reaction? Give the major products of ANY TWO of the following chemical reactions.

i \[ \bigodot \ + \ CH_3-CH_2-CH_2-Cl + AlCl_3 \rightarrow \]

ii \[ \bigodot-CHO + HNO_3/H_2SO_4 \rightarrow \]

iii \[ \bigodot -NO_2 + HNO_3/H_2SO_4 \rightarrow \]

1(c) Describe the mechanism of ANY ONE of the following chemical reactions and give the major products.

i \[ \bigodot-NH-CO-CH_3 + HNO_3/H_2SO_4 \rightarrow \]

ii \[ CH_3-\bigodot-Cl + NaOH \rightarrow \]

2 Discuss ANY THREE of the following topics with the help of suitable examples. [5+5+5]

i Curtin-Hammett principle
ii Trapping of reaction intermediate
iii Classical carbocations
iv Steric effect in substitution reactions

3(a) Describe the mechanism and stereochemistry of the products of ANY ONE of the following chemical reactions. [4+3]

i \[ 2 \ CH_3-CHO + NaOH \rightarrow \]

ii \[ CH_3-CHO + C_2H_5O-CO-CH_2-Cl + :B \rightarrow \]

3(b) Give the chemistry of preparation of ANY TWO of the following organic compounds. [4+4]

i \[ CH_2-CO-CH(OH)-CH_3 \text{ (Acyloan)} \]

ii \[ \bigodot-O \text{ (Acyloan)} \]

iii \[ CH_3-CO-CH_2-CO-OC_2H_5 \text{ (\beta-Ketoester)} \]

4(a) Write the reaction mechanisms of ANY TWO the following chemical reactions. [4+4]

i Wittig reaction
ii Glaser-Coupling reaction
iii Peterson reaction

4(b) Give the mechanism of hydroxylation/hydroboration reaction of alkenes. [2]

4(c) Describe the pyrolytic elimination of sulphoxides. [5]
2017-18
M.Sc. I SEMESTER EXAMINATION
POLYMER SCIENCE & TECHNOLOGY
INORGANIC CHEMISTRY
(AC-1513)

Maximum Marks: 60
Credits: 04
Duration: Two Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. | Questions | M.M.
--- | --- | ---
1(a) | What are carboranes? Classify them on basis of Wade’s rule and discuss any one of them. | [5]
(b) | Discuss preparation, properties, structure and bonding of diborane. | [5]
(c) | Write short notes on any two of the followings: 
a) Borazine 
b) Sulphur nitrogen compounds 
c) Oxyacids of phosphorous or sulphur | [5]
2(a) | Write the IUPAC names of the following coordination compounds with explanation of the rules and also draw the possible geometrical and optical isomeric structures. 
(i) [CoCl2(en)2]^+ 
(ii) [Pt(NH3)2Cl2] | [5]
(b) | Discuss the factors influencing stability of coordination complexes in detail with proper examples. | [5]
(e) | Write short notes on any two of the followings: 
(i) Crystal field theory 
(ii) Valence bond theory and its limitations 
(iii) Isomerism in octahedral complexes | [5]
3(a) | Discuss the synthesis, back-bonding and synergic interaction in metal carbonyls. | [6]
(b) | Discuss the valence bond concept for metal carbonyls and structure elucidation of metal carbonyls from infra-red spectroscopy. | [3]
(e) | What are pi acceptor ligands? Discuss phosphorous compounds as pi acceptor ligands. | [6]
4(a) | What are the chemical essential elements in biological systems? How essentiality has been defined? Draw the dose–response curve to elaborate the importance of essential elements. | [4]
(b) | What are the biological functions of alkali metals? | [2]
(e) | Write short notes on any three of the followings: 
(i) Haemoglobin 
(ii) Vitamin B12 
(iii) Na/K pump 
(iv) cytochromes | [9]
2017-18
M.Sc. (1 SEMESTER) EXAMINATION
(POLYMER SCIENCE & TECHNOLOGY)
(AUTUMN SEMESTER)
ANALYTICAL CHEMISTRY
AC-1514

Maximum Marks: 60
Credits: 04
Duration: Two Hours

Answer all the questions.

Q.No. Questions
1(a) From the following two sets of results for a number of individual examples, calculate the correlation coefficient of the data, taking your method as \( x \) and standard method as \( y \).

<table>
<thead>
<tr>
<th>Sample</th>
<th>your method, ( x )</th>
<th>standard method, ( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10.2</td>
<td>10.5</td>
</tr>
<tr>
<td>B</td>
<td>12.7</td>
<td>11.9</td>
</tr>
<tr>
<td>C</td>
<td>8.6</td>
<td>8.7</td>
</tr>
<tr>
<td>D</td>
<td>17.5</td>
<td>16.9</td>
</tr>
<tr>
<td>E</td>
<td>11.2</td>
<td>10.9</td>
</tr>
<tr>
<td>F</td>
<td>11.5</td>
<td>11.1</td>
</tr>
</tbody>
</table>

OR

1(a') A soda sample (\( \text{Na}_2\text{CO}_3 \)) is analyzed by two different methods, giving the following results for the percentage of \( \text{Na}_2\text{CO}_3 \):

<table>
<thead>
<tr>
<th>Method 1</th>
<th>Method 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \bar{x}_1 = 42.34 )</td>
<td>( \bar{x}_2 = 42.44 )</td>
</tr>
<tr>
<td>( s_1 = 0.10 )</td>
<td>( s_2 = 0.12 )</td>
</tr>
<tr>
<td>( N_1 = 5 )</td>
<td>( N_2 = 4 )</td>
</tr>
</tbody>
</table>

(i) Are \( s_1 \) and \( s_2 \) significantly different? (Given \( F_{\text{tab}} = 6.59 \) for \( N_1 = 5 \) and \( N_2 = 4 \))
(ii) Are the two means significantly different at the 95% probability level? (Given: \( t_{\text{tab}} = 2.365 \) at the 95% probability level for 7 degrees of freedom)

\[ \text{Contd.} \]
1(b) A chemist determined the percentage of iron in an ore, obtaining the following results: 
\[ \bar{x} = 15.30, s = 0.10, N = 4. \]
Calculate (i) 90% confidence interval of the mean (given \( t = 2.353 \) for \( N = 4 \)) and (ii) 99% confidence interval of the mean (given: \( t = 5.843 \) for \( N = 4 \)).

2(a) Discuss the classification of chromatography on the basis of mechanism of separation. Write the principle and applications of adsorption chromatography.

2(b) Write notes on ANY TWO of the following:

(i) Size exclusion chromatography  
(ii) Selectivity coefficient  
(iii) Preconcentration of metals by ion exchange chromatography

3(a) Explain the concept of theoretical plates. Calculate the number of theoretical plates, when the retention time and peak width at base are 52.3 mm and 9.0 mm, respectively. Comment on the efficiency of column.

**OR**

3(a') What is flame ionization detector? Write its advantages and disadvantages over other detectors used in gas chromatography.

3(b) Write notes on ANY TWO of the following:

(i) Reverse phase HPLC  
(ii) UV-Visible detector of HPLC  
(iii) Retention time and retention volume

4(a) The amount of \( ^{14} \text{C} \) present in animal bones after \( t \) years is given by \( N_t = N_0 \exp(-0.00012t) \) a bone has lost 18% of its \( ^{14} \text{C} \). How old are the bones? (half-life of \( ^{14} \text{C} \) is 5720 years).

4(b) Explain the principle and working of neutron activation analysis. What are its advantages and disadvantages?

4(c) Explain the estimation of hemoglobin by copper sulphate method.
2017-18
1 YEAR M.SC. (I SEMESTER) EXAMINATION
POLYMER SCIENCE & TECHNOLOGY
CORROSION AND CORROSION CONTROL
(AC-1516)

Maximum Marks: 60
Credits: 04
Duration: Two Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. | Question | M.M.
--- | --- | ---
1 | Explain ANY THREE of the followings:
   (a) Economic consequences of corrosion
   (b) Factors influencing the rate of corrosion
   (c) Mechanism of corrosion under the drop of NaCl solution
   (d) Pourbaux diagram of iron by giving chemical reactions occurring during its corrosion in different pH regions. | [5×3]

2 | Explain the following forms of corrosion (ANY TWO). Give the mechanism and suggest the method to control it.
   (a) Galvanic Corrosion
   (b) Pitting Corrosion
   (c) Selective leaching Corrosion | [7.5×2]

3 | Discuss any Two of the following:
   (i) Corrosion control by material selection and design
   (ii) Cathodic protection
   (iii) Green corrosion inhibitors | [7.5×2]

4(a) | List the factors influencing the hot corrosion. Discuss any two of them. | [7.5]

4(b) | Discuss any one of the following:
   (i) Sulfidation model of hot corrosion
   (ii) Basic fluxing model | [7.5]
Old Course/Backlog

2017-18
M.Sc. (I SEMESTER) EXAMINATION
(POLYMER SCIENCE & TECHNOLOGY)
PHYSICAL CHEMISTRY-I
AC-511

Maximum Marks: 70
Credits: 04
Duration: Two Hours

Answer all the questions.

<table>
<thead>
<tr>
<th>Q.No.</th>
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<tbody>
<tr>
<td>1(a)</td>
<td>Describe the collision theory of reaction rate.</td>
<td>[6]</td>
</tr>
<tr>
<td>1(b)</td>
<td>Name the different methods used for the determination of rate law. Discuss one of them in detail.</td>
<td>[6]</td>
</tr>
<tr>
<td>1(c)</td>
<td>What is activation energy? Calculate the AE of a reaction whose rate constant is tripled by rise in temperature from 22 °C to 32 °C. (Given $R = 8.314 , J, K^{-1}, mol^{-1}$)</td>
<td>[5.5]</td>
</tr>
<tr>
<td>OR</td>
<td></td>
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<tr>
<td>1(e')</td>
<td>Write a note on ‘Oscilatory Chemical Reactions’.</td>
<td></td>
</tr>
<tr>
<td>2(a)</td>
<td>Discuss the Maxwell-Boltzmann statistics.</td>
<td>[5.5]</td>
</tr>
<tr>
<td>OR</td>
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<td></td>
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<tr>
<td>2(a')</td>
<td>Explain the factorisation of molecular partition function into translational, rotational, vibrational and electronic parts.</td>
<td></td>
</tr>
<tr>
<td>2(b)</td>
<td>Discuss ANY THREE of the following:</td>
<td>[3×4]</td>
</tr>
<tr>
<td></td>
<td>(i) Microstates and macrostates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) Thermodynamic probability and entropy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii) Canonical partition function</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iv) Statistical weight factor</td>
<td></td>
</tr>
<tr>
<td>3(a)</td>
<td>Describe the Gibbs-Duhem-Margules equation and discuss its relevance in ideal solution.</td>
<td>[7.5]</td>
</tr>
<tr>
<td>3(b)</td>
<td>Write notes on ANY TWO of the following:</td>
<td>[2×5]</td>
</tr>
<tr>
<td></td>
<td>(i) Gibb’s-Duhem equation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) Raoult’s law and its deviation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii) Determination of fugacity of a gas</td>
<td></td>
</tr>
<tr>
<td>4(a)</td>
<td>Discuss the effect of solvent on rate of reaction.</td>
<td>[5.5]</td>
</tr>
<tr>
<td>4(b)</td>
<td>Write notes on ANY TWO of the following:</td>
<td>[2×6]</td>
</tr>
<tr>
<td></td>
<td>(i) Secondary salt effect</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) Relaxation method</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii) Effect of cohesive energy density on reaction rate</td>
<td></td>
</tr>
</tbody>
</table>
# Old Course/Backlog

**2017-18**  
M.Sc. (I SEMESTER) EXAMINATION  
(POLYMER SCIENCE & TECHNOLOGY)  
(AUTUMN SEMESTER)  
ANALYTICAL CHEMISTRY  
AC-514  
Credits: 04  
Duration: Two Hours

**Answer all the questions.**

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<tr>
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<tbody>
<tr>
<td>1(a)</td>
<td>Giving a suitable example discuss the complexometric titration. Explain why precipitation titration is less popular?</td>
<td>[7.5]</td>
</tr>
</tbody>
</table>
| 1(b)  | Discuss ANY TWO of the followings:  
(i) Standard deviation  
(ii) Student’s t-test  
(iii) Potentiometry                                                                                                                                 | [2×5]|
| 2(a)  | Discuss the principle and any two applications of ion exchange chromatography.                                                                                                                              | [5.5]|
| 2(b)  | Write brief notes on ANY TWO of the followings:  
(i) Solvent extraction  
(ii) Gel permeation chromatography  
(iii) High performance liquid chromatography                                                                                                   | [2×6]|
| 3(a)  | Explain the principle and working of scanning electron microscopy.                                                                                                                                         | [7.5]|
| 3(b)  | Describe the instrumentation of differential scanning calorimeter.                                                                                                                                           | [5] |
| 3(c)  | Write the applications of electrogravimetry OR flame photometry.                                                                                                                                             | [5] |
| 4(a)  | What is saponification value? How is it determined? Explain its significance.                                                                                                                                | [7.5]|
| 4(b)  | Write notes on ANY TWO of the followings:  
(i) Carbon dating  
(ii) Isotope dilution technique  
(iii) Estimation of blood sugar                                                                                                                        | [2×5]|