FACULTY OF MEDICINE, UNIVERSITY OF RUHUNA
B.Sc. Medical Laboratory Science Degree Programme
Year End Examination Year 1- 7th Batch
Chemistry (MLS 1101)-Theory

31 December 2015 Time: 8.30 – 9.30 am Duration: One (01) hour

54

- *Use of calculators is allowed.*
- *Answer **all** questions on this paper itself.*
- *Write your answer in the space provided for each question. Please note that the space provided is sufficient for the answer and that extensive answers are not expected.*

Index Number .....

For Examiner's Use Only

Question No	Marks
1	
2	
3	
4	
5	
Total	
Percentage	

24

01. Answer **all** parts.

(a) (i) Rank the following compounds in the order of increasing boiling points. *(06 marks)*

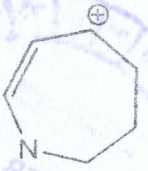
$CH_3(CH_2)_4OH$	$C(CH_3)_4$	$C(CH_3)_2OHCH_2CH_3$	$CH_3(CH_2)_4CH_3$
A	B	C	D

(ii) (a) Which of the following compound/s can form hydrogen bonds with themselves? *(03 marks)*

CH_3OH C_2H_6 $(CH_3)_3N$

(b) Draw the possible hydrogen- bonded structure/s to support your answer in (a). *(04 marks)*

(iii) Write the resonance structures for the following compound and indicate which of the resonance structures are the major contributors. **(07 marks)**



(b) (i) Write down the structures of possible isomers of dichloroethene. Which of them will have zero dipole moment (μ)? *(06 marks)*

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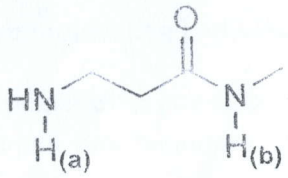
(ii) Which proton ($H_{(a)}$ or $H_{(b)}$) in the following compound is more acidic. Explain how you arrive at your answer. *(06 marks)*



(iii) Draw the staggered conformations of 2, 3-dichlorobutane in the order of increasing energy. *(06 marks)*

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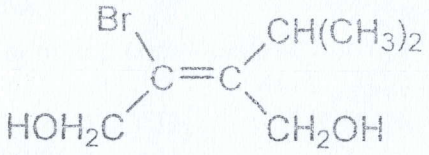
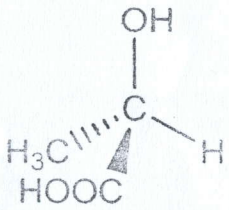
(c) (i) Assign E/Z configuration to the following compound.



(05 marks)

(ii) Draw the Fischer projection of the following compound and name the compound giving (*R*) or (*S*) designation

(10 marks)



(iii) Draw the conformers of trans- 1,2-dimethylcyclohexane and state which conformer is of lower energy.

(07 marks)

02. Answer **all** parts.

(a) (i) Give the correct symbol for each of the following radioactive particles: (*04 marks*)

(I) Alpha particle (II) Beta particle (III) Gamma ray (IV) Positron

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(ii) Arrange the above radioactive particles in the order of the following properties:

(I) The order of penetrating power of particle from lowest to highest: ***(02 marks)***

(II) The deviation in an electric field from lowest to highest: ***(02 marks)***

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(iii) Define the term artificial radioactivity or nuclear transmutation. ***(02 marks)***

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(b) (i) Cobalt-57 has a half-life of about 272 days. If a sample has an initial mass of 2.24 g and undergoes decay until it has a mass of 0.140 g. How many days does it take for the above process? ***(03 marks)***

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(ii) The radioactive $^{213}_{83}Bi$ emits an alpha particle. The product of this reaction emits a β^- particle.

(I) What is the final product? ***(02 marks)***

(II) Give complete nuclear equations for the above two processes. ***(02 marks)***

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(iii) Suggest a method that uses radiation chemistry to measure blood volume in the body. ***(03 marks)***

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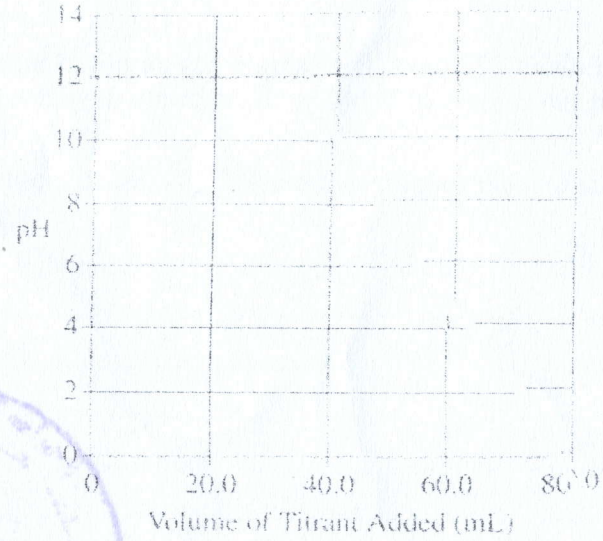
03. Answer **all** parts.

(a) (i) On the grid provided sketch the approximate titration curves for the titration of: ***(03 marks)***

(I) 40.00 mL of 0.1000 *mol dm*$^{-3}$ HCl with 0.1000 *mol dm*$^{-3}$ of NaOH

(II) 40.00 mL of 0.1000 *mol dm*$^{-3}$ HCOOH ($K_a = 1.8 \times 10^{-4}$) with 0.1000 *mol dm*$^{-3}$ of NaOH



(ii) Give three major differences between these two curves? *(03 marks)*

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(iii) Calculate the pH at 50% neutralization points of the titration of a 40.00 cm^3 sample of 0.1000 *mol* dm^{-3} HCOOH and with 0.1000 *mol* dm^{-3} of NaOH,. *(02 marks)*

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(iv) Indicate whether the indicator methyl red ($pK_a = 5.1$) is suitable for both titrations. *(02 marks)*

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(b) (i) Name the most important complexing agent employed in complexometric titrations. *(01 mark)*

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(ii) How the equivalence point is detected in complexometric titration? *(02 marks)*

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(iii) Which type of ligand is *ethylenediaminetetraacetic* acid? *(01 marks)*

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(iv) A 35.00 mL sample containing Ni(II) is treated with 20.00 mL of 0.0200 *mol* dm^{-3} EDTA. All of the Ni(II) is complexed leaving an excess of EDTA. Titration of the excess EDTA required 9.77 mL of 0.0212 *mol* dm^{-3} Mg(II). What is the concentration of Ni(II) in the original solution? ***(04 marks)***

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(c) Acetone has two absorption maxima in its UV absorption spectrum. The longer wavelength absorption (274 nm) is very weak (ε = 12), while the shorter wavelength absorption (195 nm) is much stronger (ε = 900).

(i) Sketch an approximate UV spectrum of acetone. ***(05 marks)***

(ii) Classify the above absorptions based on the orbitals involved (i.e. n, π, π^*, σ, σ^*) and briefly explain their relative energies and intensities. ***(04 marks)***

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(iii) A 3.25×10^{-5} *mol* dm^{-3} aqueous acetone solution has a transmittance of 18.4% when measured in a 1.0 cm quartz cell at a wavelength of 274 nm. Calculate the absorbance of this solution. *(03 marks)*

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(d) A 5.00 mL sample of blood was treated with trichloroacetic acid to precipitate proteins. After centrifugation, the resulting solution was brought to a pH of 3 and was extracted with two 5 mL portions of methyl isobutyl ketone containing the organic lead complexing agent APCD. The extract was aspirated directly into an air-acetylene flame yielding an absorbance of 0.444 at 283.3 nm. Five-milliliter aliquots of standard solutions containing 0.250 and 0.450 ppm Pb(II) were treated in the same way and yielded absorbance values of 0.396 and 0.599.

(i) Give a series of reactions to show the processes leading to free gaseous lead atoms from lead complex PbL. *(04 marks)*

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(ii) Calculate the concentration Pb (ppm) in the blood sample. *(06 marks)*

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04. Answer **all** parts

(a) (i) Explain the following terms pertaining to thermodynamics.

(I) Open system, closed system and isolated system *(05 marks)*

(II) Endothermic reaction and exothermic reaction *(05 marks)*

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(ii) First and second laws of thermodynamics are mathematically expressed by du = dq + dw and dq = Tds, respectively. Here work done on the system, $dw = -p_{ex}dV$, where dV is the volume change against the external pressure p_{ex} and dq is the heat absorbed by the system. Write down the corresponding expressions for work for each of the following three processes: ***(3 x 5 marks)***

(I) Free expansion against the zero external pressure

(II) Expansion against the constant external pressure

(III) Reversible expansion

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(iii) Three moles of an ideal gas in an initial state of 100 K and 2 dm^3 volume were isothermally expanded to ten-fold of its initial volume.

(I) Calculate the work done by the system. ***(05 marks)***

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(II) What is the heat change in the system? *(05 marks)*

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(III) What is the entropy change? *(05 marks)*

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(b) (i) Explain the order of entropy change from gas to liquid to solid? *(05 marks)*

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(ii) 64 g of an organic compound lowered the freezing point of 100 g of benzene by 0.256 K. Cryoscopic constant of benzene is 5.12 $K\,kg\,mol^{-1}$

(I) How many moles of the compound were dissolved in the benzene? *(7.5 marks)*

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(II) What was the molar mass of the compound? *(7.5 marks)*

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05. Answer all parts.

(a) Based on which principle, the components in a mixture are separated in the Normal Phase Thin Layer Chromatography. *(04 marks)*

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(b) Explain briefly how the separation takes place in above (a) *(05 marks)*

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(c) "X" is a mixture known to contain cyclohexanal and cyclohexanol. Suggest the best solvent system out of ethyl acetate and hexane to be used in better separation of the two components in the "X" using normal phase TLC. *(06 marks)*

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(d) List out five advantages of Gas-Liquid Chromatography. *(05 marks)*

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