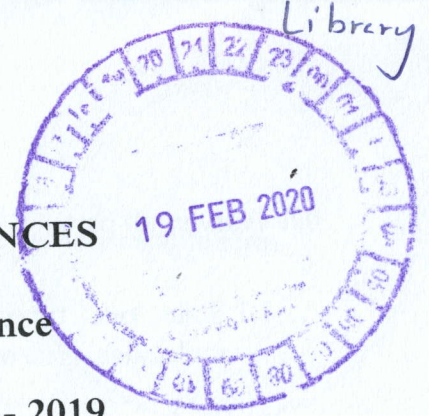# FACULTY OF ALLIED HEALTH SCIENCES
UNIVERSITY OF RUHUNA
Department of Medical Laboratory Science

Year End Examination, Year 1 - 10th Batch - 2019
Basic Sciences - Chemistry (MLS 1101) – SEQ

Monday 11th February 2019   Time: 9.00 a.m. - 10.00 a.m.   Duration: 1 hour

- *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	

1

01. Answer **all** parts.

    1.1 State **two** types of inter-molecular (noncovalent) interactions that exist between molecules, give one example for each type.

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[10 marks]

    1.2 State what factors would determine the polarity of a chemical bond.

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[10 marks]

    1.3 What is the hybridization of carbon atoms in ethylene molecule (CH_2CH_2)?

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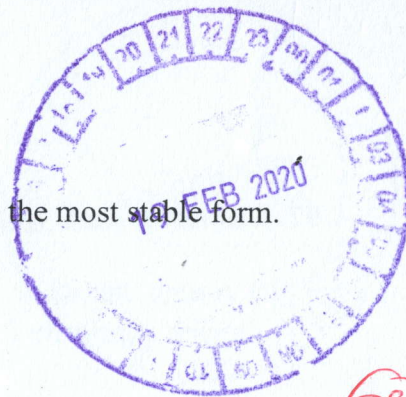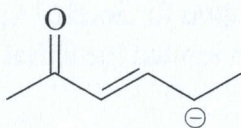
[05 marks]

    1.4 Draw the molecular-orbital **energy-level** diagram for the double bond of ethylene.

[25 marks]

1.5 Draw resonance forms for the following molecule and underline the most stable form.

[25 marks]

1.6 Which of the following phenols is more acidic? Draw the conjugate bases and briefly explain your answer.

A

B

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[25 marks]

3
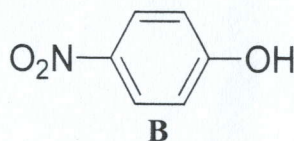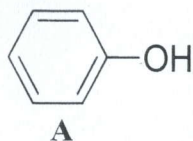
02. Answer all parts

2.1 Assign the (R) or (S) configuration for each of the following molecules indicating the order of priority for each group around the chiral carbon.
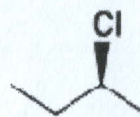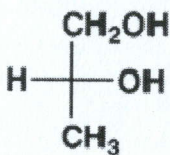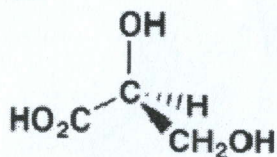
2.2 Draw a graph of potential energy verses angle of bond rotation (0-360°) for C2-C3 bond in butane, and draw relevant Newman projections for each conformation.

2.3. Write balanced nuclear equations for the following transformations:

2.3.1   Iodine-122 decays to xenon-122.

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2.3.2   Neodymium-141 undergoes electron capture.

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[*20 marks*]

2.4 Cobalt-60 has a half-life of 5.26 yrs. The Co-60 in a radiotherapy unit must be replaced when its radioactivity falls to 75% of the original sample. If the original sample was purchased in September 2018, when will it be necessary to replace Co-60?

[*20 marks*]

2.5 Briefly describe how Iodine-131 is used as a radiotracer in the clinical laboratory.

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[*10 marks*]

03. Answer **all** parts.

3.1 Given the following curve for the titration of 50.00 mL of a weak acid (HA) with a strong base (NaOH):
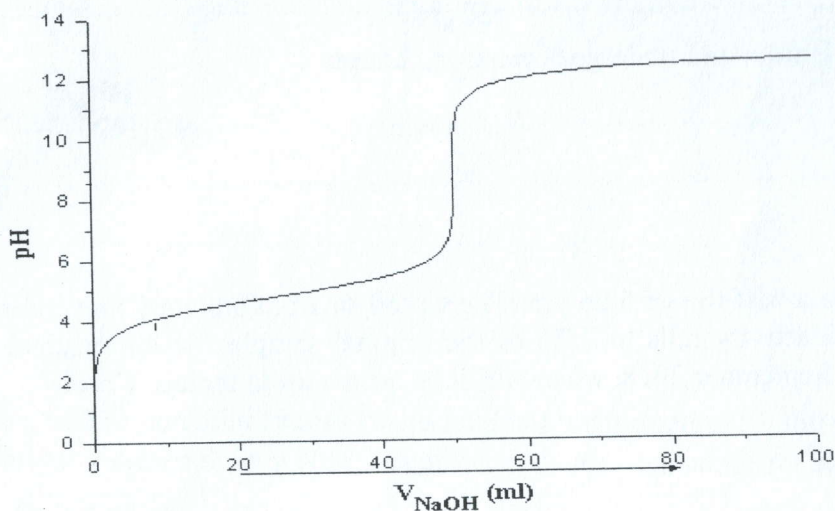
3.1.1 Indicate **on the curve** where the titration behaves as a buffer.

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[*10 marks*]

3.1.2 Estimate the pK_a of the weak acid.

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[*10 marks*]

3.1.3 Estimate the pH at the equivalence point.

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[*10 marks*]

3.1.4 Why is the pH at the equivalence point not 7.0?

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[*10 marks*]
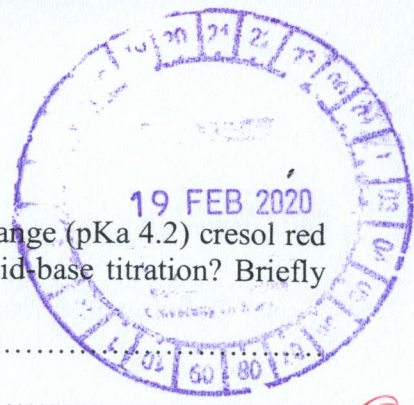
3.1.5 What would be an appropriate indicator among metyl orange (pKa 4.2) cresol red (pKa 8.3), thymolphthalein (pKa 9.9) to use for this acid-base titration? Briefly give reasons.

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[10 marks]

3.2 EDTA is the most widely used chelating agent in complexometric titrations. Draw the chemical structures of EDTA and metal-EDTA complex.

[10 marks]

3.3 What is the volume of 0.0500 $mol\ dm^{-3}$ EDTA required in a titration with a 50.00 mL of:

    3.3.1   0.0100 $mol\ dm^{-3}$ Ca^{2+} 3.3.2 0.0100 $mol\ dm^{-3}$ Al^{3+}

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[10 marks]

3.3.3 Write balanced chemical equations for the reactions of the above two metal ions.

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[10 marks]

3.3.4 Calculate pCa and pAl at the beginning of the titration.

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[20 marks]

04. Answer **all** parts.

4.1 Defining each term, state the first law of thermodynamics in a mathematical form.

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[*10 marks*]

4.2 Four moles of an ideal gas in an initial state of 300 K and 2 dm^3 volume were isothermally expanded to a final volume of 20 dm^3. Calculate the work done by the system using the equation $w = -nRT \ln \dfrac{V_f}{V_i}$

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[*10 marks*]

4.3 Write down the general expression that relates the free energy, enthalpy and entropy changes in a reaction under standard conditions.

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[*10 marks*]

4.4 Glucose-6-phosphate is formed from glucose in an ATP utilizing reaction.

4.4.1   Write the overall reaction

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[05 marks]

4.4.2   Using the following information calculate the ΔG^0 of the above overall reaction.

Glucose + P_i $\leftrightarrow$ Glucose-6-P + H_2O $\Delta G^0 = +14$ kJ/mol

ATP + H_2O $\leftrightarrow$ ADP + P_i $\Delta G^0 = -31$ kJ/mol

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[10 marks]

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4.4.3 Giving reasons, indicate whether the overall reaction is spontaneous or not.

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[05 marks]

4.5 What is a colligative property of a solution?

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[10 marks]

4.6 Give two examples for colligative properties.

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[10 marks]

4.7 Briefly explain why a solution of 1 *mol dm*$^{-3}$ NaCl and 2 *mol dm*$^{-3}$ Glucose has the same boiling point elevation.

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[30 marks]

05. Answer all parts

5.1 Approximately 44% of the light at 250 nm was transmitted through a 0.0025 $mol\ dm^{-3}$ solution of caffeine. 91% of the light at 300 nm was transmitted through the same solution.

5.1.1 Assuming a 1cm path length calculate the molar absorptivity at each wavelength.

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[20 marks]

5.1.2 Which wavelength would be the most useful for constructing a calibration curve? and why?

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[10 marks]

5.2 What are the differences in instrument design in Atomic Absorption Spectroscopy and Atomic Emission Spectroscopy and how are the observed signals generated?

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[20 marks]

10

5.3 Explain briefly how separation of compounds in a mixture takes place in Thin Layer Chromatography.

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[10 marks]

5.4 What is meant by partition chromatography? What is the nature of stationary phase and mobile phase in this chromatography?

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[10 marks]

5.5 Give two examples of chromatographic methods which belong to planar chromatography.

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[10 marks]

5.6 What is meant by "retention time" in Gas Chromatography (GC)?

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[10 marks]

5.7 Which type of samples/compounds can be analyzed in Gas–Liquid chromatography? How is a mixture of fatty acids analyzed in GC?

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[10 marks]

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