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FACULTY OF ALLIED HEALTH SCIENCES UNIVERSITY OF RUHUNA
DEPARTMENT OF MEDICAL LABORATORY SCIENCE
Second End-Semester Examination – July 2023 – 2020/2021 Batch

MLS1222 Basic Chemistry II – Theory (SEQ)

Date: 25th July 2023 Time: 9.00 am -10.00 am

- *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	
Total	
Percentage	

1. Answer **all** parts.

1.1 Write a mathematical relationship between absorbance and transmittance.

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(10 marks)

1.2 Intensity of a particular wavelength of radiation incident on a solution of 0.500 mol dm^{-3} concentration of an absorbing substance is reduced to one-fourth of the initial value after passing through the 1.00 cm length of the solution. Calculate the molar extinction coefficient of the substance.

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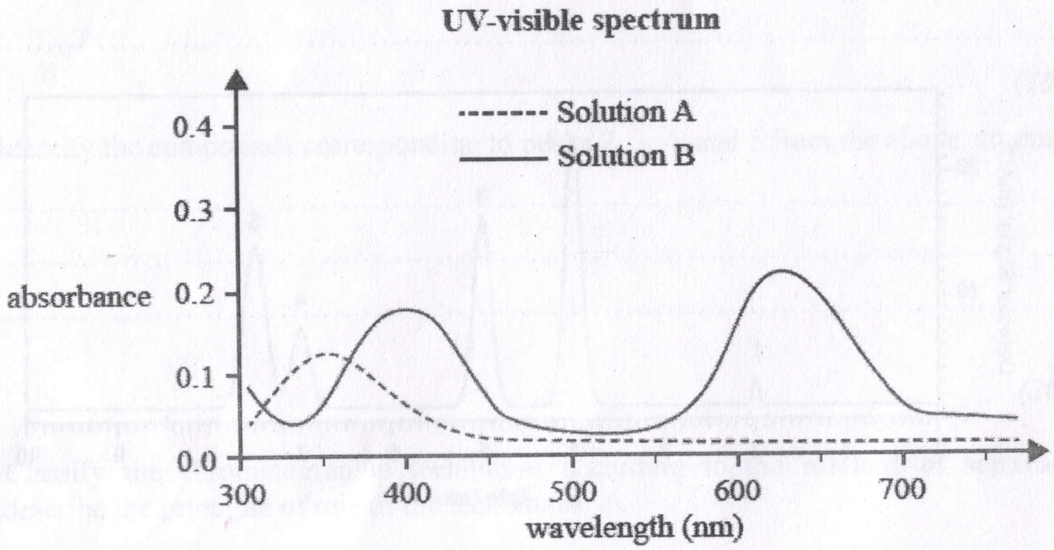
(20 marks)

1.3 In the space provided below draw a schematic diagram of a single beam UV visible spectrophotometer and label its main components.

(30 marks)

1.4 Following graph shows the overlay UV-visible spectra of two solutions **A** and **B.** One of the solutions is yellow in colour and the other one is green. Identify the solutions **A** and **B** relevant to colours.



A - ....

B - ....

(20 marks)

1.5 A mixture was prepared by adding 10.00 mL of solution **A** with 10.00 mL of solution **B**, which wavelength should be used to measure the absorbance of the species in solution **B** in this mixture? Justify your answer.

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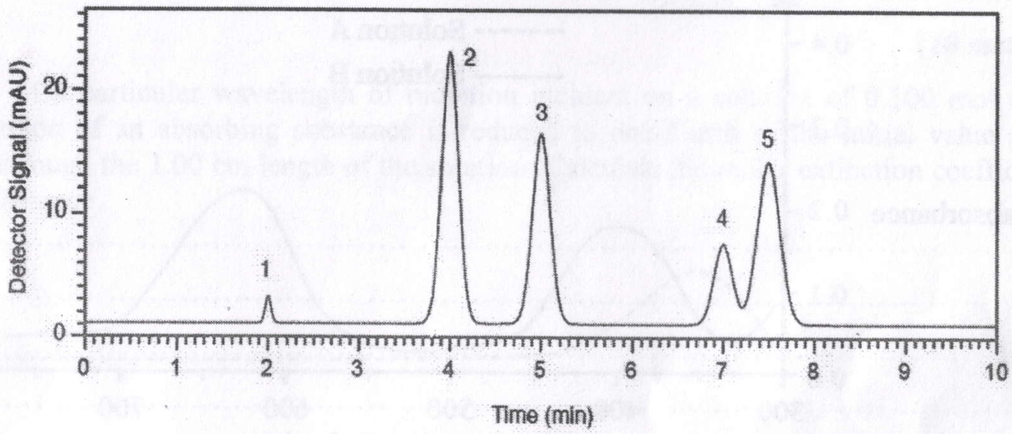
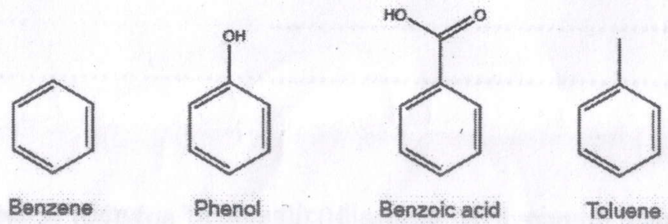
(20 marks)

02. Answer <u>all</u> parts.

A sample containing benzene, phenol, benzoic acid, and toluene was analyzed by HPLC. The following chromatagram was obtained for the separation of the above compounds in a **reverse phase** column.





2.1 Calculate the number of theoretical plates for the compound corresponding to the peak 2.

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(20 marks)

2.2 Calculate the retention factor for the compound corresponding to the peak 3.

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(20 marks)

2.3. How would you change the composition of the mobile phase to improve the resolution of peaks 4 and 5?

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(10 marks)

2.4. Identify the compounds corresponding to peaks 2, 3, 4, and 5 from the above structures.

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(20 marks)

2.5 Classify the chromatographic techniques according to the **method of separation** and describe the principle of **one** of the techniques.

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(30 marks)

03. Answer **all** parts.

The following oxidation reduction reaction occurs spontaneously in acidic solution.

$$MnO^{4-} + 5Fe^{2+} + 8H^{+} \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$$

A solution containing $KMnO_4$ and H_2SO_4 is poured into one beaker, and a solution of $FeSO_4$ is poured into another beaker. A salt bridge is used to join the two solutions in the two beakers. A platinum rod is placed in each solution and the two platinum rods are connected by a wire that passes through a voltameter.

3.1 Sketch a diagram for the above described cell. Indicate clearly the **anode**, the **cathode**, **direction of electron movement** throught the external circiut, and the **direction of migration of cations and anions** through the salt bridge.

(30 marks)

3.2 Calculate the emf of this cell under the standard conditions using standard reduction potentials given bellow:

$Fe^{2+}_{(aq)} + e^{-} \rightarrow Fe^{3+}_{(aq)}$ $E° = +0.77$ V

$MnO^{4-}_{(aq)} + 5e^{-} \rightarrow Mn^{2+}_{(aq)}$ $E° = +1.51$ V

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(10 marks)

3.3 Apply the Nerst equation ($E = E° - (0.0592/n)\log Q$) and **calculate** the emf of the cell when the concentrations are as follows: pH = 0.0 $[Fe^{2+}]$ = 0.10 M, $[MnO_4^-]$ = 1.50 M and $[Fe^{3+}]$= 2.5×10^{-4} M, $[Mn^{2+}]$ = 0.010 M.

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(20 marks)

3.4 A certain reaction is non-spontaneous at -25 °C. The entropy change for the reaction is 95 J/K. What can you conclude about the **sign** and the **magnitude** of ΔH ?

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(20 marks)

3.5 A solution of 0.64 g of adrenalene in 0.36 g of CCl_4 elevates the boiling point by 0.49 °C. Calculate the molar mass of adrenalene. (K_b CCl_4 = 5.02 °C/m)

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(20 marks)

04. Answer **all** parts.

4.1 In a nuclear transmutation, uranium-238 is bombarded with α particles and a neutron is ejected from each target nuclei. Predict the product nucleus and write equation for this nuclear reaction.

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(15 marks)

4.2 If 1.00 g of strontium-90 is left in a container, 0.953 g will remain after two years. Calculate the half-life of strontium-90.

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(20 marks)

4.3 Calculate how much of the initial 2.00 g would remain after 5 years.

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(25 marks)

4.4 Chlorine-36 is a convenient radiotracer. It is weak β emitter with a half-life of 3×10^5 years. Describe how you would use this radiotracer to determine effect of soil pH on the uptake of chloride ion from the soil by soybeans.

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(25 marks)

4.5 A novel silicone elastomer contact lens was designed for simultaneous viewing of distance and near eye displays in 2023. State **three** properties this material should possess to be used as contact eye lens.

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(15 marks)

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