

**University of Ruhuna- Faculty of Technology**  
**Bachelor of Biosystems Technology Honors Degree**  
**Level 1 (Semester I) Examination, December 2025**  
**Academic year 2024/2025**

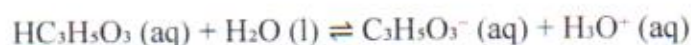
**Course Unit: BST 1162 Analytical Chemistry (Written)**

**Duration: 1 and ½ hours**

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- Answer only **three (3)** questions. Write your answers in a separate answer book.
- Each question should start on a new page.
- If you answer more than three questions, only the **first three** will be marked.

1. Lactic acid ( $\text{HC}_3\text{H}_5\text{O}_3$ ) is a weak acid commonly used in the food and pharmaceutical industries, with a dissociation constant  $K_a = 1.38 \times 10^{-4}$  at  $25^\circ\text{C}$ . The dissociation is given by:



- a. Describe an experimental method to determine the acid dissociation constant ( $K_a$ ) of lactic acid ( $\text{HC}_3\text{H}_5\text{O}_3$ ) in aqueous solution. (20marks)
- b. Calculate the pH of a  $0.25 \text{ mol L}^{-1}$  lactic acid solution at  $25^\circ\text{C}$ . (30 marks)
- c. Determine the pH of a  $0.18 \text{ mol L}^{-1}$  sodium lactate solution at  $25^\circ\text{C}$ . (50 marks)  
 (At  $25^\circ\text{C}$   $K_w = 1.0 \times 10^{-14} \text{ mol}^2 \cdot \text{dm}^{-6}$ )

**(Total: 100 marks)**

2. Phosphoric acid ( $\text{H}_3\text{PO}_4$ ) is a triprotic acid commonly used in fertilizers and food additives. A concentrated technical grade solution has the following specifications.

**85% w/w  $\text{H}_3\text{PO}_4$**

**Density = 1.69 g/mL**

**Purity = 90%**

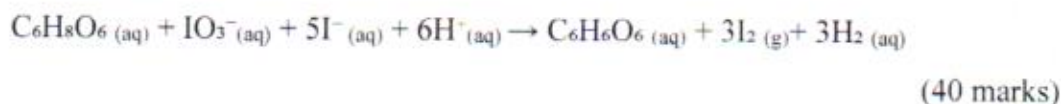
- a. Briefly describe difference of Primary standard and Secondary standard solutions with relevant examples. (20 marks)
- b. Calculate the molarity of the concentrated  $\text{H}_3\text{PO}_4$  solution as provided. (40 marks)
- c. Calculate the volume of the concentrated  $\text{H}_3\text{PO}_4$  solution required to prepare 750.00 mL of a 0.02 M  $\text{H}_3\text{PO}_4$  solution. (40 marks)  
 \*(Molar mass of  $\text{H}_3\text{PO}_4 = 98 \text{ g} \cdot \text{mol}^{-1}$ )

**(Total: 100 marks)**

3. Answer to all parts

- a. Explain the fundamental difference between accuracy and precision. (20 marks)
- b. Discuss the importance of significant figures in analytical chemistry. (20 marks)
- c. Discuss the sources of errors that can affect accuracy and precision in analytical measurements. (20 marks)
- d. In an iodometric titration, a 0.912 g sample containing ascorbic acid ( $C_6H_8O_6$ ) is dissolved and titrated with  $0.0505 \text{ mol L}^{-1}$   $KIO_3$  in acidic medium with excess KI. The titration requires 24.65 mL to reach the starch endpoint. Calculate the percentage (w/w) of ascorbic acid in the sample.

The relevant reaction is:



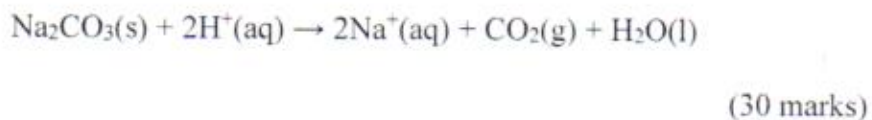
**(Total: 100 marks)**

4. Industrial wastewater contaminated with sulfuric acid ( $H_2SO_4$ ) requires neutralization before discharge. Sulfuric acid fully dissociates in two steps in dilute solution. The overall dissociation is as follows.



A 100.000 L batch of wastewater has an initial pH of 2.50.

- a. Calculate the initial concentration of  $H^+$  ions (in mol/L) and the total moles of  $H^+$  present in the wastewater tank. (30 marks)
- b. Determine the mass of solid sodium carbonate ( $Na_2CO_3$ , Molar mass = 105.99 g/mol) required to completely neutralize the acidic wastewater. The neutralization reaction is:



- c. A buffer solution is prepared by mixing equal volume of 0.25 M ammonia ( $NH_3$ ) and 0.15 M ammonium chloride ( $NH_4Cl$ ). Calculate the pH of the buffer. ( $K_b$  of  $NH_3 = 1.8 \times 10^{-5}$ ) (40 marks)

**(Total: 100 marks)**

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