



UNIVERSITY OF SWAZILAND
Faculty of Health Sciences
Department of Environmental Health Science

B.Sc. DEGREE IN: - ENVIRONMENTAL MANAGEMENT &
OCCUPATIONAL SAFETY AND HEALTH
- ENVIRONMENTAL MANAGEMENT
AND WATER RESOURCES

MAIN EXAMINATION PAPER 2017

TITLE OF PAPER : WASTEWATER MANAGEMENT
COURSE CODE : EHM 418
DURATION : 2 HOURS
MARKS : 100

INSTRUCTIONS : READ THE QUESTIONS & INSTRUCTIONS CAREFULLY
: ANSWER **ANY FOUR** QUESTIONS
: EACH QUESTION **CARRIES 25** MARKS.
: WRITE NEATLY & CLEARLY
: NO PAPER SHOULD BE BROUGHT INTO THE EXAMINATION ROOM.
: BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER.

DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED BY THE INVIGILATOR.

QUESTION ONE (Marks are indicated for each question)

1A. Show the outlet tracer test profile diagram using salt tracer for the following flow conditions:

- i. Plug flow tank[2 ½ marks]
- ii. Completely mixed flow tank.[2 ½ marks]

Assume that 100 gm of salt is added to the inlet and the volume of the tank in each case is 4 m^3 . The wastewater flow rate is $2 \text{ m}^3/\text{hr}$.

1B. Compare and contrast the performances of the following wastewater treatment processes[5 marks]

- i. Lagoons
- ii. Aerated lagoons
- iii. Activated sludge.

1C. List four techniques used for particle size measurement in wastewater quality control.[5 marks]

1D. A wastewater is to be treated in a plug flow reactor. Assuming that the reaction rate is irreversible and first order ($r = -kC$) with a reaction rate coefficient equal to 3.6 /day, determine the flow rate that can be treated if the reactor has a volume of 200 m^3 and 98% treatment efficiency is required.[10 marks]

QUESTION TWO (Each question below carries 5 marks)

- 2A.** Describe the role of surfactants in the formation of stable oil emulsions in wastewater.
- 2B.** What test can be used to determine the concentration of settleable solids in wastewater?
- 2C.** What treatment techniques can be used for the removal of volatile organic carbon from wastewater?
- 2D.** For what type of situations are mechanically cleaned bar screens preferred to manually cleaned bar screens?
- 2E.** List the types of oil that may be present in wastewater treatment processes and the treatments needed to remove each type of oil.

QUESTION THREE (Each question below carries 5 marks)

3A. Define the following terms used in relation to chemical unit processes:

- i. Extinction coefficient [1 mark]
- ii. Gas stripping ...[1 mark]
- iii. Advanced oxidation[1 mark]
- iv. Photolysis[1 mark]
- v. Reverse osmosis[1 mark]

3B. Figure Q3-1 below shows the solubility diagrams of aluminum and iron with respect to pH of wastewater. Discuss the relative importance of pH control on the efficiency of coagulation in wastewater using these two different metals.

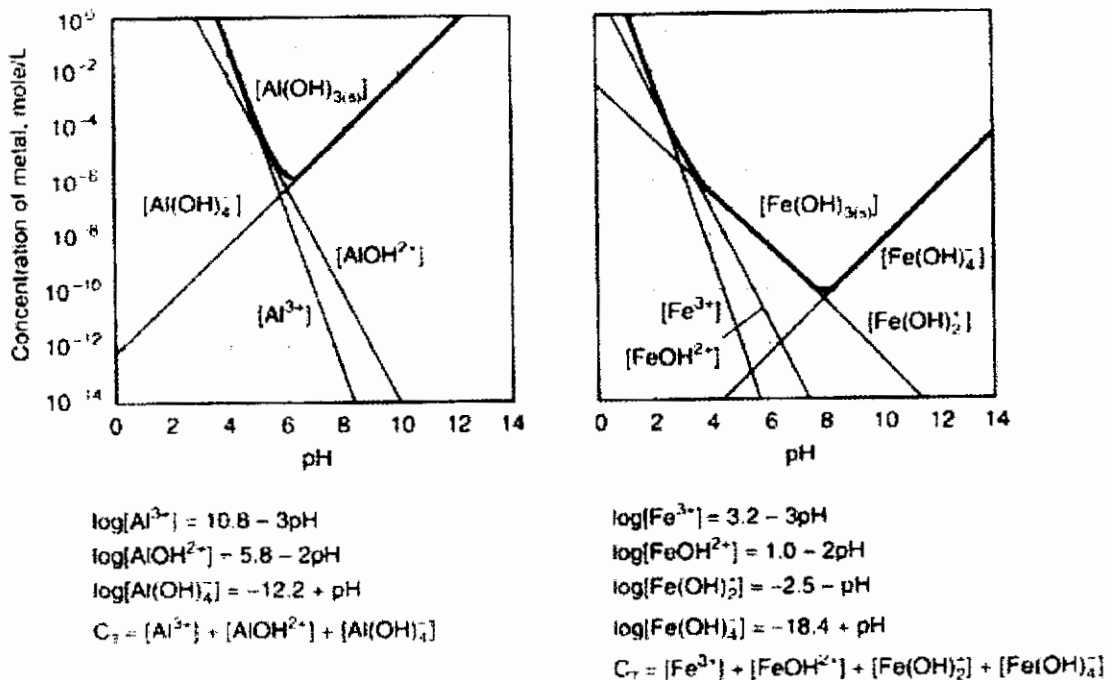
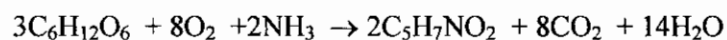


Figure Q3-1: Solubility diagrams of aluminum and iron with respect to pH of wastewater

- 3C.** List possible chemical treatment methods employed for the removal of phosphorus from wastewater
- 3D.** List five typical applications of chemical oxidation processes in wastewater treatment
- 3E.** List the advantages and disadvantages of advanced oxidation processes for wastewater treatment.

QUESTION THREE (5 marks for each question)

- 4A.** The chemical formula shown below represents the breakdown of glucose by aerobic bacteria and the formation of new bacterial cells and metabolic byproducts. Based on this reaction, determine the cell yield coefficient



- 4B.** Describe with the help of a diagram the pre anoxic and post anoxic denitrification processes.
- 4C.** Describe the sources of sludge bulking and the mechanisms employed to control sludge bulking in activated sludge processes
- 4D.** Describe the possible causes and remedies for clogging in percolating filter systems
- 4E.** List possible advantages and disadvantages of anaerobic treatment processes

QUESTION FIVE (Each question below carries 5 marks)

- 5A.** Describe the sources of solids in wastewater treatment processes and the sequential treatment/stabilization processes typically employed to produce bio-solids suitable for agricultural application.
- 5B.** List possible sludge processing strategies used to reduce or eliminate pathogens from sludge.
- 5C.** Describe briefly the four discrete steps used in environmental risk analysis
- 5D.** Describe water pinch analysis and the benefits it provides.
- 5E.** Describe the sources of odours in wastewater treatment plants and the mechanism that can be placed to minimize odours.