



ZIMBABWE

**MINISTRY OF HIGHER AND TERTIARY EDUCATION,
INNOVATION, SCIENCE AND TECHNOLOGY
DEVELOPMENT**

**HIGHER EDUCATION EXAMINATIONS COUNCIL
(HEXCO)**

NATIONAL DIPLOMA

IN

WATER AND SANITATION MANAGEMENT

MODULE: Sludge Treatment, Reuse and Disposal PAPER NO: 511/23/M07

DURATION: 3 Hours

NOVEMBER/ DECEMBER 2025 EXAMINATION

REQUIREMENTS

Pen, Pencil, Ruler

INSTRUCTIONS TO CANDIDATES

Answer any five questions.

This paper consists of 3 printed pages.

QUESTION 1

- a) Differentiate between water treatment sludge and wastewater treatment sludge. (4 marks)
- b) Describe how sludge is produced in wastewater treatment during primary and secondary treatment. (8 marks)
- c) Explain the chemical composition of sludge, highlighting key contaminants and nutrients. (8 marks)

QUESTION 2

- a) According to your own thinking, why is there, the need to treat sludge at a wastewater treatment facility. (5 marks)
- b) In the process of sludge treatment at a treatment facility, sludge is stabilised, state and explain the processes that take place during the following:
 - i) Biological stabilisation (5 marks)
 - ii) Chemical stabilisation (5 marks)
 - iii) Thermal stabilisation (5 marks)

QUESTION 3

- a) As a wastewater and water technician, sludge is being disposed without it being treated, what are the likely effects of such phenomenon to the environment. (5 marks)
- b) Assess the sludge drying bed method explaining all the key components and processes involved. (15 marks)
- c) Explain the significance of sludge thickening during the treatment of sludge. (5 marks)

QUESTION 4

- a) Compare the condition of high-rate digestion and standard rate digestion. (4 marks)
- b) Describe the key parameters monitored to ensure efficient digestion. (5 marks)
- c) Define the following terms:
 - i) Detention time (2 marks)
 - ii) Sludge volume index (SVI) (2 marks)
 - iii) Sludge mass (2 marks)
- d) Explain the step-by-step procedures involved in commissioning a new sludge digester. (5 marks)

QUESTION 5

- a) Evaluate the different methods of recycling sludge. (5 marks)
- b) Evaluate the use of sludge as a supplemental fuel source, highlighting the environmental advantages and drawbacks. (10 marks)
- c) Analyse how the reuse of sludge in agriculture can lead to soil heavy metal pollution. (5 marks)

QUESTION 6

- a) You are a wastewater treatment plant operator and your facility is facing challenges in achieving adequate pathogen removal. Propose a step-by-step treatment process that ensures effective pathogen reduction, explaining the role of each stage. (10 marks)
- b) Suggest two (2) key operational controls that should be monitored to maintain effective pathogen removal and justify their importance. (10 marks)

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