

NATIONAL EXAMINATION, MAY 2016

04-ENV-A4-Water and Wastewater Engineering

3 hours duration

Notes:

1. Question 1 is compulsory, attempt any three questions from the remaining four questions.
2. If doubts exist as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
3. This is a closed book exam. However, one aid sheet is allowed written on both sides.
4. An approved calculator is permitted.
5. Marks of all questions are indicated at the end of each question.
6. Clarity and organization of answers are important.

Q1 (25 marks)

Define and explain the following terms in water and wastewater engineering

- i. Nitrification in wastewater treatment (5 marks)
- ii. A "Blank Sample" and "Seed" in the standard BOD₅ test (5 marks)
- iii. Oxygen sag curve in stream pollution (5 marks)
- iv. Temporary and Permanent Hardness in water (5 marks)
- v. Headloss and Backwashing in Filtration (5 marks)

Q2 (25 marks)

- a. Name and describe the various species of Phosphorus (P) in municipal wastewater treatment. Explain the two key mechanisms of P removal in wastewater treatment. (15 marks)
- b. Explain the importance of organic compounds and ammonia on chlorination based disinfection of water. Give two advantages and two disadvantages of UV disinfection over chlorination for disinfection. (10 marks)

Q3 (25 marks)

- a. Define pH and explain its significance for water treatment with special regards to disinfection and coagulation-flocculation. (10 marks)
- b. 3 ml of a raw sewage sample diluted to 300 mL in a BOD bottle had an initial DO of 8.5 mg/L. After 4 days of incubation at 20°C, the DO in the sample was measured at 4.5 mg/L. Assuming 5% of the oxygen demand over this 4 day period being contributed by the seed in the sample, determine the cBOD₅ day and ultimate BOD of the sample. (15 marks)

Q4 (25 marks)

- a. 50 mL of a water sample required 5 mL of 0.02N H₂SO₄ to reach the end point with phenolphthalein as indicator (pH 8.3), and 8 mL of 0.02N H₂SO₄ to reach the end point with Bromocresol Green (pH 4.5). Name the type of alkalinity indicated by each of these end points and determine the value of each alkalinity. Also what other type of alkalinity value can you calculate from these two observations, and what is its value? (10 marks)
- b. Describe anaerobic digestion of municipal wastewater sludge with special reference to the digestion mechanism and the key operating parameters of an anaerobic digester. (15 marks)

Q5 (25 marks)

Give a brief description of the following in water and wastewater treatment:

- a. Chemical and biological phosphorus removal (6 marks)
- b. Ion exchange process in water treatment (7 marks)
- c. Discrete settling and flocculent settling (6 marks)
- d. Surface overflow rate and Solids loading rate of a secondary clarification in wastewater treatment (6 marks)