

NATIONAL EXAMINATION, MAY 2018

16-CIV-B5-Water Supply 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. One of two calculators is permitted - any Casio or Sharp approved model.
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 briefly describe the significance of the following parameters or processes in water or wastewater treatment.

- i. Backwashing in filtration **(5 marks)**
- ii. F/M ratio in wastewater treatment **(5 marks)**
- iii. Mixed liquor suspended solids and return activated sludge **(5 marks)**
- iv. Break-point chlorination **(5 marks)**
- v. Sludge Volume Index **(5 marks)**

Q2 (25 marks)

- a. With the help of the chemical equation involved, explain how the water pH influences the disinfection efficiency **(12 marks)**
- b. List the key requirements of an adequate water distribution system. Discuss the advantages and disadvantages of grid iron and dead-end system. **(13 marks)**

Q3 (25 marks)

- a. 25 mL of a sludge sample was filtered through a standard filter paper weighing 1.1234 g and dried at 105°C in an oven. The weight of the filter paper after drying in the oven was 1.2345 g. The filter paper was then ignited in a muffle furnace at 550°C and the weight of the residue after ignition was 0.0234 mg/L.
 - i. Determine the TSS, VSS and fixed suspended solid in the sample in mg/L. **(7 marks)**
 - ii. Comment on the impact on the test results if the muffle furnace temperature was set at 900°C by mistake. **(3 marks)**
- b. With the help of a diagram describe the principal and working of a high-rate anaerobic digester. **(15 marks)**

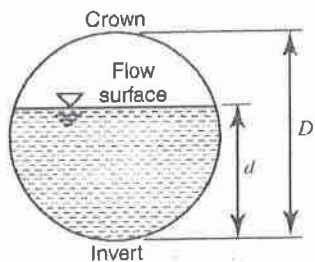
Q4 (25 marks)

Draw the process schematic of a water treatment plant that has a raw water source with 150-200 NTU of turbidity, 300 mg/L of hardness, iron concentration of 1.0 mg/L and seasonal taste and odours. Show all liquid and solid streams, chemical injection points, and expected water quality with regards to hardness, turbidity, iron and pathogens after treatment. **(25 marks)**

Q5 (25 marks)

The invert elevation of a 500-mm sewer drops by 1.0 m over a 200 m distance. Determine the discharge and flow velocity in the sewer when flowing 30% full. Assume $n = 0.013$. Refer the pipe flow curves provided on the next page. **(25 marks)**

Partial Flow in Pipes



Nomenclature:
 d = partial depth
 D = full depth or pipe diameter
 q = partial discharge
 Q = full-flow discharge
 v = velocity, partially full
 V = velocity, full

