

**Exam #1**

March 11, 1997

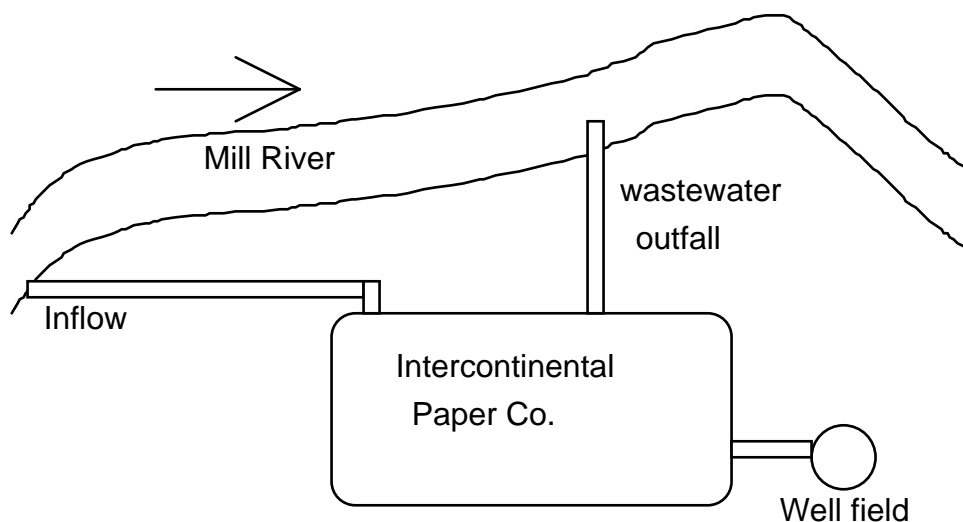
Please answer all 5 questions. Show all work. Be neat, and box-in your answer.

**1. An alum floc particle has a density of 1.04 g/mL and a diameter of 0.01 mm. (25 points)**

- Assuming it is subject only to discrete settling, what is its settling velocity at 5°C in cm/s?
- Is this particle likely to settle out in a tank that is 10 m deep and has a mean hydraulic residence time of 6 hours? Why?
- At what rate will this particle settle in 30°C water (in cm/s)?

**2. Intercontinental Paper and the Mill River (20 points)**

The Intercontinental Paper Co. is discharging its wastewater directly into the Mill River. The discharge flow is 3.8 ft<sup>3</sup>/s (cfs). They obtain half of this water from an intake 0.5 miles upstream of the wastewater outfall, and half from groundwater via a nearby well field. On average, the Mill River water upstream of IPC has a total suspended solids concentration (TSS) of 5.5 mg/L. If the Mill River has a flow of 12 cfs upstream of the IPC intake, and if the state permits a maximum TSS concentration of 15 mg/L in the Mill River, what will the allowable effluent concentration of suspended solids be for IPC?



**3. Calculate the ThOD of the following wastewaters: (20 points)**

- a.  $10^{-3}$  moles/L of hexane,  $C_6H_{14}$
- b.  $3 \times 10^{-3}$  moles/L of oxalic acid,  $C_2H_2O_4$
- c. 30 mg/L of ethanol,  $CH_3CH_2OH$

**4. Calculate the concentration of the following wastewaters as mg-Carbon/L: (20 points)**

- a.  $10^{-3}$  moles/L of hexane,  $C_6H_{14}$
- b.  $3 \times 10^{-3}$  moles/L of oxalic acid,  $C_2H_2O_4$
- c. 30 mg-ethanol/L,  $CH_3CH_2OH$

**5. Short Answer (15 points)**

- a. Name and describe the three types of reactors discussed in class. Explain how they differ (10 points)
- b. What is an autotrophic organism? (3 points)
- c. What distinguishes a carboxylic acid from other chemical substances? (2 points)

## Appendix

Some physical constants of Water:

Temp., °C	Density, kg/m <sup>3</sup>	Viscosity x 10 <sup>3</sup> , N-s/m <sup>2</sup>	Kinematic Viscosity x 10 <sup>6</sup> , m <sup>2</sup> /s
0	999.8	1.781	1.785
5	1000.0	1.518	1.519
10	999.7	1.307	1.306
15	999.1	1.139	1.139
20	998.2	1.002	1.003
25	997.0	0.890	0.893
30	995.7	0.798	0.800
35	994.0	0.725	0.729
40	992.2	0.653	0.658

Selected Chemical Constants

Element	Symbol	Atomic #	Atomic Wt.	Valence	Electronegativity
Aluminum	Al	13	26.98	3	1.47
Boron	B	5	10.81	3	2.01
Calcium	Ca	20	40.08	2	1.04
Carbon	C	6	12.01	2,4	2.50
Cerium	Ce	58	140.12	3,4	1.06
Helium	He	2	4.00	0	
Holmium	Ho	67	164.93	3	1.10
Hydrogen	H	1	1.01	1	2.20
Magnesium	Mg	12	24.31	2	1.23
Manganese	Mn	25	54.94	2,3,4,6,7	1.60
Osmium	Os	76	190.2	2,3,4,8	1.52
Oxygen	O	8	16.00	2	3.50
Potassium	K	19	39.10	1	0.91
Sodium	Na	11	22.99	1	1.01
Sulfur	S	16	32.06	2,4,6	2.44