

# CE 111 Exam 2 Practice I

Time: 45 minutes

Name \_\_\_\_\_

Please write your name in the space provided above and sign the Berkeley Honor Code at the end.

This is an open-book/open-note exam. Communication with other students in any form is prohibited during the exam.

Answer questions in the space provided following each question. Use extra blank page if you need more room. Please make sure that you write the final answer in the box when provided.

For problems that require calculations, you must clearly show the steps that you used in arriving at the answer. For such problems, presenting only the final answer without relevant steps will not be given any credit.

1. (8 points) Please calculate the hardness and alkalinity of the following water.

- (a) Total Hardness: \_\_\_\_\_ mg/L as  $\text{CaCO}_3$ .
- (b) Carbonate Hardness: \_\_\_\_\_ mg/L as  $\text{CaCO}_3$ .
- (c) Alkalinity: \_\_\_\_\_ mg/L as  $\text{CaCO}_3$ .
- (d) There is one major common anion missing from the table. It is \_\_\_\_\_, and the concentration is \_\_\_\_\_ mg/L.
- (e) The COD of the water is \_\_\_\_\_ mg/L, and the BOD of the water is \_\_\_\_\_ mg/L.
- (f) What process in a drinking water facility could contribute to the removal of decane?

Component	C (mg/L)
$\text{Ca}^{2+}$	80
$\text{Na}^+$	46
$\text{Mg}^{2+}$	12
$\text{HCO}_3^-$	122
$\text{SO}_4^{2-}$	9.6
$\text{Fe}^{2+}$	11.2
$\text{K}^+$	11.7
$\text{C}_6\text{H}_{12}\text{O}_6$ (sugar)	270
$\text{C}_{10}\text{H}_{22}$ (Decane, non-biodegradable)	71
pH7	

2. (4 points) A river has a flowrate of  $10 \text{ m}^3/\text{s}$  and reoxygenation rate of  $0.5 \text{ day}^{-1}$ . The river water contains 10 mg/L BOD and 8 mg/L Dissolved Oxygen (DO) before the discharging point of a cheese factory. A cheese factory discharges 10 MGD high-organic wastewater into the river and the wastewater contains 200 mg/L BOD and 0 mg/L DO. The deoxygenation rate of the river after receiving the wastewater is  $0.3 \text{ day}^{-1}$ . The river water temperature remains constant at  $15^\circ\text{C}$  and the oxygen solubility at  $15^\circ\text{C}$  is 10 mg/L. What is the DO level in the river after the river water travels 100 km downstream at a speed of 1 m/s?
3. (2 points) Which of the following species in a brackish water contribute the most to the osmotic pressure of the water?
- (a) 0.1 M NaCl
  - (b) 0.07 M  $\text{Na}_2\text{SO}_4$
  - (c) 0.08 M  $\text{CaCl}_2$
  - (d) 0.2 M  $\text{C}_6\text{H}_{12}\text{O}_6$

What is the minimum energy to treat this brackish water?

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4. (3 points) A wastewater treatment facility has a flowrate of  $0.4 \text{ m}^3/\text{s}$  through a sedimentation tank with  $L=55\text{m}$  (length),  $W=10.7\text{m}$  (width), and  $H=3.0\text{m}$  (depth). For spherical particles with a density of sand ( $2.65 \text{ g/cm}^3$ ), what is the diameter of the smallest particle that can be removed with 100% efficiency? ( $g=980 \text{ cm/s}^2$ ,  $\mu = 0.01 \text{ g/cm/s}$ )

$\mu\text{m}$

5. (3 points) A municipal drinking water facility discovers pesticide in the water and decide to use PAC for the pesticide removal. Research found the isotherm for the removal to be  $q_e = 266C_e^{0.41}$ , where  $C_e$  and  $q_e$  have the unit of  $\text{mg/L}$  and  $\text{mg/g}$ , respectively. The facility needs to treat  $0.4 \text{ m}^3/\text{s}$  water, and the untreated water contains  $1 \text{ mg/L}$  pesticide. The MCL for the pesticide in drinking water is  $0.04 \text{ mg/L}$ . Please calculate the daily PAC consumption in the facility.

$\text{g/d}$

Signature: \_\_\_\_\_

I pledge my honor that I have not violated the Berkeley Honor Code during this examination.

**This is the end of the exam.**