

系所組別： 環境工程學系甲組

考試科目： 衛生工程

考試日期： 0219, 節次： 1

※ 考生請注意：本試題 可 不可 使用計算機

1. A water with the concentration of major ions as shown below
  - (1) Calculate the total hardness, carbonate hardness, and noncarbonate hardness (all expressed in mg/L as CaCO<sub>3</sub>) (10%)
  - (2) Explain the basic principle of lime-soda ash softening. (10%)
  - (3) Fluidized bed crystallization can also be used for water softening. Explain this process and its advantage over lime-soda ash process. (5%)

Ca <sup>2+</sup> = 101 mg/L	SO <sub>4</sub> <sup>2-</sup> = 88.4 mg/L
Mg <sup>2+</sup> = 4.75 mg/L	Cl <sup>-</sup> = 27.0 mg/L
Na <sup>+</sup> = 14.0 mg/L	HCO <sub>3</sub> <sup>-</sup> = 210 mg/L

(Atomic mass C: 12, O: 16, Ca: 40, Mg: 24.3, Na: 23, S: 32, Cl: 35.4)
2.
  - (1) What are *Giardia* and *Cryptosporidia*? What are their impacts on public water supply? (10%)
  - (2) Sketch a flow diagram of a conventional water treatment process. How can the breakthrough of *Giardia* and *Cryptosporidia* in a conventional water treatment process be prevented? (10%)
3. Explain the “Water Safety Plans” which are advocated by WHO (World Health Organization) for safeguarding the public health with respect to drinking water supply. (15%)
4. Answer the following questions related to sludge treatment
  - (1) What is the purpose of sludge conditioning, and how to do it? (10%)
  - (2) Explain the operational principle of two sludge dewatering devices, namely “belt filter press” and “plate and frame filter press” (10%)
5. There are two sewer reaches, Reach 1 and Reach 2. Reach 1 begins at MH (manhole) 1, and ends at MH 2, while Reach 2 begins at MH 2 and ends at MH 3. The length of Reach 1 is 100 m, while that of Reach 2 is 120 m. The design flow for Reach 1 is 40 L/s and for Reach 2 it is 95 L/s. The ground elevation at MH 1 is 350.00 m, at MH 2 it is 347.87 m, and at MH 3 it is 345.77 m. The local building code specifies 250 mm as the smallest pipe permissible, and the minimum depth of cover over the top of the sewer is 2.50 m. Assume the slope of the sewers is parallel to that of the ground surface. Design the size of the sewers, and give the elevation of the inverts of Reach 1 and Reach 2 at MH 1, MH 2, and MH 3. Assume the commercially available sewer pipe sizes are 250, 300, 375 and 450 mm, and wall thickness of all pipes is 0.05 m. (Manning equation  $V = (1/n) R^{2/3} S^{1/2}$ ,  $n = 0.013$ ) (20%)