

國 立 清 華 大 學 命 題 紙

98 學年度 生醫工程與環境科學系 系(所) 乙(環境分子科學) 組碩士班入學考試

科目 環境化學 科目代碼 2405 共 2 頁第 1 頁 \*請在【答案卷卡】內作答

1. Please define or explain the following terms. (30%)

- (a) Algal bloom
- (b) Formal potential
- (c) Industrial ecology
- (d) Carbon footprint
- (e) Green chemistry
- (f) Debye-Hückel limiting law.

2. An industrial factor discharges  $100 \text{ m}^3/\text{d}$  wastewater which contains  $200 \text{ mg/L}$  TOC ( $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ ) into a small stream at  $20^\circ\text{C}$ . The dissolved oxygen (DO) concentration in the stream is assumed to be 80 % of the saturation DO concentration at  $20^\circ\text{C}$ . How many liters of the stream water could be contaminated to the extent of removing all the DO by microbial degradation. (8%)

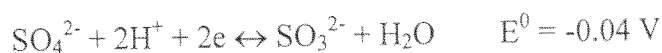
3. The following data were obtained from the analysis of river water at pH 9.3.

$\text{Ca}^{2+}$ : 70 mg/L,  $\text{Mg}^{2+}$ : 19.7 mg/l,  $\text{Pb}^{2+}$ : 1.5 mg/L;  $\text{Na}^+$ : 6.9 mg/L ;  $\text{HCO}_3^-$ : 155 mg/l as  $\text{CaCO}_3$ ;

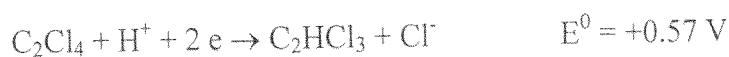
$\text{SO}_4^{2-}$ : 106 mg/l ;  $\text{Cl}^-$ : 15.6 mg/L

- (a) Please use bar diagram to show the correctness of the analyzed results. Give reasons to your answer. (7%)
- (b) If you select this river water as the source of drink water and decide to use lime-soda method to decrease the hardness. Please calculate the required lime and soda per liter. (8%)

4. The half-reaction for reduction of sulfate to sulfite in groundwater is



- (a) What is the redox potential of this half-reaction at  $25^\circ\text{C}$  if it takes place in the presence of 1 mM sulfite and 0.1 mM sulfate at a pH 8? (5%)
- (b) If the groundwater contains 1 mg/L tetrachloroethylene ( $\text{C}_2\text{Cl}_4$ ), please calculate the final concentration of trichloroethylene ( $\text{C}_2\text{HCl}_3$ ), a major product from the dechlorination of tetrachloroethylene, under such conditions. (Assume your parameters if needed) (5%)



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5. Global warming is one of most important issues for environmental science and technology in the 21st century.

(a) Please describe the formation mechanism of global warming in terms of greenhouse gases. (7%)

(b) Water moisture has strong IR adsorption bands at around 1700-1800 and near 4000  $\text{cm}^{-1}$ .

However, water moisture does not be considered as a greenhouse gas. Please explain the reason.

(5%)

6. Please draw the chemical structures of the following chemicals. (10%)

(a) polychlorinated dibenzo-*p*-dioxin

(b) DDT

(c) PAN

(d) Freon 112

(e) polychlorinated biphenyls (PCBs)

7. Air-to-fuel ratio (AF ratio) is one of the important criteria for combustion. Please calculate the AF ratio when 1 g of 95 unleaded gasoline was burned. How many gram of  $\text{CO}_2$  will be produced? (You can assume that the 95 unleaded gasoline is equivalent to 95% 2,2,4-trimethylpentane and 5% pentane). (8%)

8. Clay is one of the most important minerals for determining the texture as well as adsorption capability of soils. The structure of clay can be simply classified as 1:1 (e.g.: kaolinite) and 2:1 structures (e.g. montmorillonite). Explain what are 1:1 and 2:1 structures? Why is 2:1 clay more useful in adsorption of metal ions? (7%)

Note: The atomic masses of elements are as follows:

H = 1.0

C = 12.0

N = 14.0

O = 16.0

Ca = 40.0

Na = 23.0

Mg = 24.3

Al = 27.0

S = 32.1

Cl = 35.5

K = 39.1

Pb = 207.2