

國立清華大學 命題紙

99 學年度 生醫工程與環境科學 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) Activity coefficient.
- (b) Common ion effect.
- (c) Lewis acid.
- (d) PAN.
- (e) Isomorphic substitution.
- (f) Free radicals.

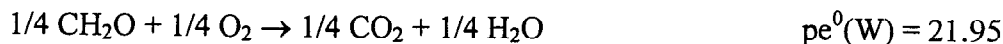
2. The rate constant,  $k$ , for the reaction between hydrogen peroxide and phenol to form carbon dioxide and water was found to vary as follows with temperature when the reactant concentrations were held constant at  $[\text{H}_2\text{O}_2] = 0.5 \text{ M}$  and  $[\text{phenol}] = 100 \text{ M}$

Temperature, °C	Rate constant, $k$ ( $\text{min}^{-1}$ )
44.5	$1.66 \times 10^{-3}$
35.0	$1.02 \times 10^{-3}$
25.7	$6.83 \times 10^{-4}$
15.1	$2.98 \times 10^{-4}$
4.5	$1.17 \times 10^{-4}$

Please determine the activation energy ( $E_a$ ) for this reaction and the value of the pre-exponential factor (A). (10%)

3. Please calculate the solution pH and compositions when 1 mM  $\text{HNO}_3$  solution was added to the solution containing 1 mM  $\text{Na}_2\text{CO}_3$ . (10%) ( $\text{H}_2\text{CO}_3$ :  $\text{p}K_{a1} = 6.3$ ;  $\text{p}K_{a2} = 10.3$ )

4. What weight of  $\text{FeCO}_3(\text{s})$  using the following equation gives the same free energy yield as 2.5 g of organic matter ( $\text{CH}_2\text{O}$ ) when oxidized by oxygen at pH 7.0 and 25 °C. (8%)



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5. Heterotrophic bacteria can use organics as the electron donor to convert nitrate into nitrogen gas. Methanol is one of the most often used organic compounds for denitrification. How many liters of methanol would be required daily for denitrification to remove the nitrogen from a  $100 \text{ m}^3/\text{d}$  sewage treatment plant producing an effluent containing  $10 \text{ mg/L}$  of nitrogen? (7%)
6. (1) Please describe Nernst equation, and explain why the redox potential decreases  $59 \text{ mV}$  as pH increase one unit at  $25^\circ\text{C}$ . (7%)
- (2) Use the Nernst equation to calculate the partial pressure of oxygen in acidic water at pH 3.5 under aerobic conditions in which  $[\text{Fe}^{2+}] = 10[\text{Fe}^{3+}]$ . ( $p\epsilon^0 = 13.2$  at  $25^\circ\text{C}$ ) (8%)
7. The air inside a garage was found to contain  $20 \text{ ppmv}$  carbon monoxide (CO) under STP conditions. What is the concentration of CO in  $\text{mg/m}^3$  at  $120^\circ\text{C}$  and at  $1.8 \text{ bar}$ . (6%)
8. Adsorption is one of the important processes to influence the fate and transport of organic pollutants as well as metal ions onto the soil.
- (1) Please describe the composition of a sandy loam soil. (7%)
- (2) Discuss the adsorption ability of organic pollutant (e.g.: PAHs) and heavy metal ions (e.g.: Cu) onto the sandy loam soils. (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
Fe = 56.0					