

# 國立中央大學八十五學年度碩士班研究生入學試題卷

所別: 環境工程研究所 甲組 科目: 環境化學及環境微生物學 共 1 頁 第 1 頁

- 1) You ran a reaction at 20°C and at 50°C. The first-order rate constant was  $10^2 \text{ S}^{-1}$  at 20°C and  $5.7 \times 10^2 \text{ S}^{-1}$  at 50°C. You then added a catalyst and found that the activation energy was reduced to 20% of the value without the catalyst. In addition, the catalyzed reaction rate was increased by five times compared with the uncatalyzed rate at 20°C. What was the catalyzed reaction rate at 50°C? ( $R=1.987 \text{ cal/mole K}$ ) (10%)
- 2) Define the following terms and describe their significance in environmental engineering: (18%)
  - (a) common ion effect
  - (b) Langmuir isotherm
  - (c) Lambert-Beer's Law
  - (d) break-point chlorination
  - (e) buffering capacity
  - (f) zeta potential
- 3) An environmental engineer can apply stresses to his system in accordance with Le Chatelier's principle to shift chemical equilibria to bring about complete reactions. List and briefly explain the methods that can be employed for this purpose. (10%)
- 4) The  $\text{CO}_2$  concentration in atmosphere is measured to be 350 ppm. Relevant equilibrium constants are listed in Tables 1 and 2, calculate the pH of rainwater which is equilibrium with  $\text{CO}_2$  at 298 K. (Show all procedures for calculation.) (12%)

TABLE 1 Ion Product of Water

Temperature, °C	$K_w$	$\text{p}K_w$	pH of a "neutral" solution ( $\{H^+\} = \{OH^-\}$ )
0	$0.12 \times 10^{-14}$	14.93	7.47
15	$0.45 \times 10^{-14}$	14.35	7.18
20	$0.68 \times 10^{-14}$	14.17	7.08
25	$1.01 \times 10^{-14}$	14.00	7.00
30	$1.47 \times 10^{-14}$	13.83	6.92
40	$2.95 \times 10^{-14}$	13.53	6.76

TABLE 2 Temperature Dependence of Some Important Carbonate Equilibrium Constants

Reaction	Temperature, °C						
	5	10	15	20	25	40	60
1. $\text{CO}_2(\text{g}) + \text{H}_2\text{O} \rightleftharpoons \text{CO}_2(\text{aq}); \text{p}K_H$	1.20	1.27	1.34	1.41	1.47	1.64	1.8
2. $\text{H}_2\text{CO}_3^* \rightleftharpoons \text{HCO}_3^- + \text{H}^+; \text{p}K_{a,1}$	6.52	6.46	6.42	6.38	6.35	6.30	6.30
3. $\text{HCO}_3^- \rightleftharpoons \text{CO}_3^{2-} + \text{H}^+; \text{p}K_{a,2}$	10.56	10.49	10.43	10.38	10.33	10.22	10.14
4. $\text{CaCO}_3(\text{s}) \rightleftharpoons \text{Ca}^{2+} + \text{CO}_3^{2-}; \text{p}K_{s0}$	8.09	8.15	8.22	8.28	8.34	8.51	8.74
5. $\text{CaCO}_3(\text{s}) + \text{H}^+ \rightleftharpoons \text{Ca}^{2+} + \text{HCO}_3^-; \text{p}(K_{s0}/K_{a,2})$	-2.47	-2.34	-2.21	-2.10	-1.98	-1.71	-1.40



- 5) 何謂環境微生物學? 其主要目的為何? 在其發展過程中, 環境微生物學之研究及應用重點有何轉變? (10%)
- 6) 藻類為原核或真核微生物? 為什麼? 在環境工程領域中, 藻類扮演那些重要的角色? (10%)
- 7) 那些環境因子會影響微生物之生長? 試簡要說明各因子對微生物生長之影響關係。(15%)
- 8) 好氧性、通氣性及厭氧性微生物有何不同之處? 好氧生物分解與厭氧生物分解在反應機制、電子接受者、最終產物及ATP產生數目等方面有何不同? 試簡要說明之。(15%)