

國立中央大學101學年度碩士班考試入學試題卷

所別：環境工程研究所碩士班 甲組(一般生) 科目：環境化學及環境微生物學 共 2 頁 第 1 頁
本科考試禁用計算器 *請在試卷答案卷(卡)內作答

All the equations and constants that you need are provided on Page 2.

1. Please define or explain the followings:
 - a. Alkalinity (3 points)
 - b. Hardness (3 points)
 - c. Chemical oxygen demand (3 points)
 - d. Syntrophy (3 points)
 - e. Cation-exchange capacity (3 points)
 - f. Methanogenesis (3 points)
 - g. Fecal indicator bacteria (3 points)
 - h. Polymerase chain reaction (3 points)
2. Lakes in temperate regions are often thermally stratified during summer. When this stratification occurs, the lower layer of the lake is called the *hypolimnion*, and the upper layer is called the *epilimnion*, which is well-mixed. Water from the hypolimnion of a lake has a pH of 8, and the total concentration of the carbonate species, i.e., C_T (sum of the concentration of $\text{CO}_{2(aq)}$, HCO_3^- and CO_3^{2-}), is 3 mM. The partial pressure of CO_2 is approximately $10^{-3.5}$ atm, and the dissolved oxygen concentration is zero.
 - a. Would this water lose or gain CO_2 if it were brought into contact with the atmosphere? (12 points)
 - b. If 1 mM of NO_3^- is added to the lake, as part of an unusual treatment intended to oxidize large accumulations of organic matter (designated as CH_2O) in the lake, how much will this alter C_T , after denitrification (to nitrogen gas) is complete? (8 points)
3. A flask sealed with an airtight stopper at 25°C contains 250 mL of water, 200 mL of octanol, and 50 mL of air. An unknown amount of *o*-xylene is added to the flask and allowed to partition among the phases. After equilibrium has been established, 5 mg of *o*-xylene is measured in the water. What is the total mass of *o*-xylene present in the flask? (12 points)
4. Suppose you wanted to grow bacteria in a simple freshwater medium (pH 7.6, C_T is 10^{-3} M, $[\text{Ca}^{2+}]_T$ is 10^{-4} M, $[\text{SO}_4^{2-}]_T$ is 10^{-4} M, and insignificant concentrations of other major ions) at a constant free cadmium ion 10^{-9} M.
 - a. If you added no organic ligands to your medium, how much total cadmium, i.e., $[\text{Cd}^{2+}]_T$, would you have to add to get a $[\text{Cd}^{2+}]$ of 10^{-9} ? (12 points)
 - b. If your medium contained $[\text{NTA}]_T = 10^{-5}$ M, how much $[\text{Cd}^{2+}]_T$ would you need now to get a $-\log[\text{Cd}^{2+}]$ of 9? NTA is nitrilotriacetic acid. (12 points)

注意：背面有試題

