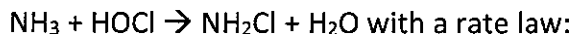


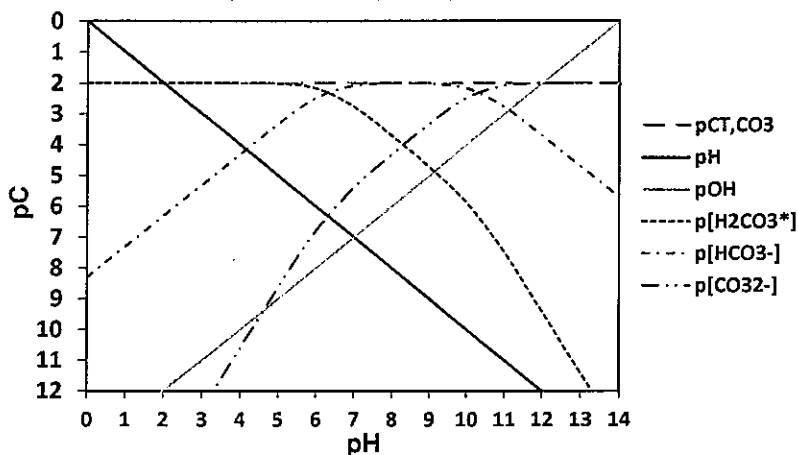
※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

- In a BOD test, assume that dissolved  $O_2$  reacts with organic pollutants to form  $H_2O$  and  $CO_2$  (i.e., complete oxidation). What is the equivalent weight of  $O_2$ ? On the other hand, in COD tests,  $Cr_2O_7^{2-}$  is used as the oxidant to oxidize the pollutants in water. What is the equivalent weight of  $Cr_2O_7^{2-}$ ? In the COD test, if 0.5 mM of  $Cr_2O_7^{2-}$  is consumed, what is the COD? (atomic weight of Cr = 52) (10%)
- The effluent from a secondary clarifier has a pH of 8.3, an ammonia ( $NH_3$ ) concentration of 34 mg/L, and is dosed with  $10^{-3}$  M HOCl. The reaction is reversible but assume conditions are such that only the forward reaction must be considered. Calculate the time for 90% of HOCl to react. (10%)



$$\frac{d[NH_3]}{dt} = -k[NH_3][HOCl], \text{ where } k = 10^6 \text{ M}^{-1}\text{s}^{-1} \text{ at } 25^\circ\text{C}.$$

- Use the pC-pH plot below, determine the pH,  $[H_2CO_3^*]$ ,  $[HCO_3^-]$ , and  $[CO_3^{2-}]$  at equilibrium when 0.01 M  $NaHCO_3$  is added to water in a close system. Explain your work in detail. (10%)



- Cadmium is a metal that has adverse impact on health. Cadmium ion ( $Cd^{2+}$ ) may be removed from water by precipitation by adjusting pH.

- What is the solubility of excess  $Cd(OH)_2(s)$  at pH = 10.0 if  $Cd(OH)_2(s) \leftrightarrow Cd^{2+} + 2OH^-$  is the only reaction to consider. (5%)
- Calculate the solubility again if complexation reactions with  $OH^-$  need to be considered. (5%)

Information that may be used: formation (stability) constants for  $Cd(OH)_2(s)$ ,  $Cd(OH)^+$ ,  $Cd(OH)_2$  are  $10^{-14.3}$ ,  $10^{-3.9}$ , and  $10^{-7.6}$ , respectively.

- Find the balanced equation and the corresponding  $E^0$  for the oxidation of  $Fe^{2+}$  to  $Fe^{3+}$  by dissolved oxygen  $O_{2(aq)}$ , forming  $H_2O$  as the product. (5%) Given  $[O_2]_{aq} = 10^{-4}$  M,  $[Fe^{3+}] = 10^{-5}$  M, and  $[Fe^{2+}] = 10^{-6}$  M at pH = 7, is the reaction at equilibrium at  $25^\circ\text{C}$ ? If not, what is the direction of the reaction? (5%) Useful information below:

| Reaction   | LogK  | pe <sup>0</sup> | E <sup>0</sup> (mV) |
|--|-------|-----------------|---------------------|
| $O_{2(g)} + 4 e^- + 4 H^+ \leftrightarrow 2 H_2O$        | 83.12 | 20.78           | 1226                |
| $O_{2(aq)} + 4 e^- + 4 H^+ \leftrightarrow 2 H_2O$       | 86.00 | 21.50           | 1268                |
| $O_{2(aq)} + 2 e^- + 2 H^+ \leftrightarrow H_2O_{2(aq)}$ | 26.34 | 13.17           | 777                 |
| $Fe^{3+} + e^- \leftrightarrow Fe^{2+}$                  | 13.03 | 13.03           | 769                 |

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環境微生物學

6. 南部某工廠的製程產生含高濃度蛋白質的廢水，此股廢水可經缺氧 (Anoxic)-好氧(Oxic)生物系統處理後，其放流水中生化需氧量與氨氮濃度均可符合法規標準，請討論此生物處理系統去除氨氮的微生物學機理？(20 分)
7. 請定義何謂總大腸桿菌群(Total Coliforms) (10 分)，並討論其對於飲用水水質的意義 (5 分)。若水體大腸桿菌群密度偏高，尋找微生物汙染來源 (Microbial Source Tracking)便成為重要工作，請問如何進行？(15 分)