環境微生物(50%)

1.　Please define the following terms: a. eubacteria, b. eucaryotics, c. endospores, d. spores (20%)

2.　Flask A contains yeast cells in glucose-minimal salts broth incubated at 30℃ with aeration. Flask B contains yeast cells in glucose-minimal salts broth incubated at 30℃ in an anaerobic jar. The yeasts are facultative anaerobes. (15%)

　　a.　Which culture produced more ATP?

　　b.　Which culture produced more alcohol?

　　c.　Which culture had the shorter generation time?

　　d.　Which culture had the greater cell mass?

　　e.　Which culture had the higher absorbance?

3.　Explain the effect of dumping untreated sewage into a pond on the eutrophication of the pond. The effect of sewage that has primary treatment? The effect of sewage that has secondary treatment? Contrast your previous answers with the effect of each type of sewage on a fast-moving river. (15%)
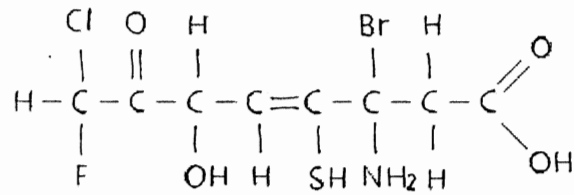
環境化學(50%)

4. (a) The mineral MnO_2(s,pyrolusite) has been found in an aquifer core. The pH of the ground water is 6.0, and the groundwater is found to contain 3.0×10^{-5} M Mn^{2+}(aq). Calculate the potential (E, in volts) for the MnO_2(s)/Mn^{2+}(aq) half reaction. (10%)

$$1/2 \, MnO_2(s) + 2H^+(aq) + e^- = 1/2 \, Mn^{2+}(aq) + H_2O \qquad pE^0=20.79$$

(b) The groundwater is also found to contain dissolved arsenic. If we assume that the arsenic is in equilibrium with manganese, what is the expected molar concentration ratio for $[AsO(OH)_2^-] / [AsO_4^{3-}]$? (10%)

$$1/2 \, AsO_4^{3-}(aq) + 2H^+ + e^- = 1/2 \, AsO(OH)_2^-{}_{(aq)} + 1/2H_2O \quad pE^0=16.53$$

5. Carbon monoxide (CO) has long been known as a highly toxic gas and important air pollutant. Near a properly adjusted gas cooking stove, CO(g) partial pressures of around 10 ppm are commonplace. At equilibrium, what concentration would be expected in water at 25℃ and 1.0 atm. total pressure? $CO_{(aq)} = CO_{(g)}$　$\Delta G^0 = -17.12$ kJ/mole, R=8.314 J/K mole (10%)

6. Given the oxidation state for each carbon atom (8 carbons from left to right), in following compound. What is average oxidation state of carbon in the entire molecule ? (5%)

$$
\begin{array}{c}
\quad\ \ \text{Cl}\quad \text{O}\quad \text{H}\qquad\qquad \text{Br}\ \ \text{H}\\
\quad\ \ |\quad\ \ \|\quad\ |\qquad\qquad |\quad\ |\\
\text{H}-\text{C}-\text{C}-\text{C}-\text{C}=\text{C}-\text{C}-\text{C}-\text{C}\overset{\displaystyle O}{\diagup}\\
\quad\ \ |\qquad\quad |\quad\ |\ \ |\quad |\ \ |\qquad \diagdown\text{OH}\\
\quad\ \ \text{F}\qquad \text{OH}\ \ \text{H}\ \ \ \text{SH}\ \text{NH}_2\ \text{H}
\end{array}
$$

7. Explain or answer the following questions: (15%)

(a) What is a Dobson unit ? If the overhead ozone concentration at a point is 250 DU, what is the equivalent thickness in millimeters of pure ozone at 1.0 atm pressure ?

(b) What is the approximate wavelength range in nm for Visible, UV-A, UV-B, and UV-C ?

(c) What is meant by photochemical smog ? What are the initial reactants in the process, Why is sunlight required ?

(d) Uses 90's rule to deduce the chemical formula for HCFC-22, CFC-113

(e) What are the main anthropogenic sources of SO_2 ? Describe two methods for removing SO_2 from smokestack emissions.