※ 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。

1. Consider a 1.2×10^{-3} mole/L glucose solution ($C_6H_{12}O_6$) that is completely oxidized to CO_2 and H_2O. Compute the amount of oxygen required to complete the reaction, and the mass of carbon dioxide would be produced. (5 points)

2. If we start with a 1.0-Ci radon-222 source, what would its activity be after 5 days? Given that the half-life of radon is 3.8 days and the natural logarithm of 8 is 2.079. (5 points)

3. Consider a 10.0×10^6 m^3 lake fed by a stream having a flow rate of 2 m^3/s and pollutant concentration of 5 mg/L. Additionally, there is a sewage outfall that discharges 0.1 m^3/s wastewater having a pollutant concentration of 200 mg/L. The decay rate coefficient for the pollutant is 0.1/day. Assuming the pollutant is completely mixed in the lake, and assuming no evaporation or other water losses or gains, compute the steady state concentration using mass balance equation. (10 points)

4. For a standard five-day BOD test,
   (1) Why isn't the ultimate BOD measured? (5 points)
   (2) Why is the test run in the dark? (5 points)

5. Sketch a schematic diagram of a typical water treatment plant. Briefly describe the function of each component. (10 points)

6. List 5 major constituents found in an average-strength municipal wastewater, and briefly describe how the wastewater treatment process (or combinations of processes) remove each constituent mentioned. (10 points)

7. Given a partial list of treatment technologies for hazardous waste treatment as: (a) separation/filtration, (b) air and stream stripping, (c) ion exchange, (d) membrane, (e) chemical precipitation, and (f) fluidized bed incineration. What are appropriate treatment technologies for each of the following types of hazardous waste streams: (each 3 points)
   (1) Corrossives
   (2) Halogenated solvents
   (3) Oily wastes
   (4) Aqueous with metals

8. Draw the chemical structure of the following dioxin and furan: (4 points each)
   (1) Octachlorodibenzo-*p*-dioxin
   (2) 2,3,4,7,8-pentachlorodibenzofuran

9. What are the "criteria pollutants" in the Air Pollution Control Act of Taiwan? (5 points)

10. A tall stack and a nearby short stack have plumes as shown in figure. Draw an atmospheric temperature profile which likely causes that pairs of plumes. Please also show the dry adiabatic lapse rate in your answer. (10 points)

Plumes

11. Food wastes are estimated to be 72% moisture, with the remaining portion containing 45% C, 6.4% H, 28.8% O, 3.3% N, and 16.5% other constituents. (5 points each)
   (1) Derive a chemical formula for the C,H,O,N portion of the waste.
   (2) Write a balanced chemical reaction showing the production of methane.
   (3) What fraction of the volume of gas produced is methane?