

1. (20%) Give a brief description or a definition of the following terminologies:
  - (a) Flocculation
  - (b) BOD<sub>5</sub>
  - (c) Material Safety Data Sheet (MSDS)
  - (d) Anaerobic digestion
  - (e) Life Cycle Analysis (LCA)
  
2. (20%) Fossil fuel contributes greatly to emissions of greenhouse gases. Using available data, one can calculate the carbon content and energy content of various fossil fuels to be as follows: coal has 708 g C/kg and 29.3×10<sup>6</sup> J/kg, petroleum has 876 g C/kg and 43×10<sup>6</sup> J/kg, and natural gas has 552 g C/m<sup>3</sup> and 39×10<sup>6</sup> J/m<sup>3</sup> (at STP).
  - (a) Assuming that all the carbon in the fuel forms CO<sub>2</sub>, compare the greenhouse gas emissions of coal, petroleum, and natural gas in terms of the moles of CO<sub>2</sub> emitted per M-Joule of energy available. (List the fuels from "best" to "worst".)
  - (b) Consider that additional greenhouse gas emissions occur during the mining and /or transport of some fossil fuels. Recalculate your part (a) values using the data below (in terms of radiative forcing, 1 g of CH<sub>4</sub> is equal to 69 g of CO<sub>2</sub>). Now, how do the fuels rank in terms of their relative greenhouse impacts?

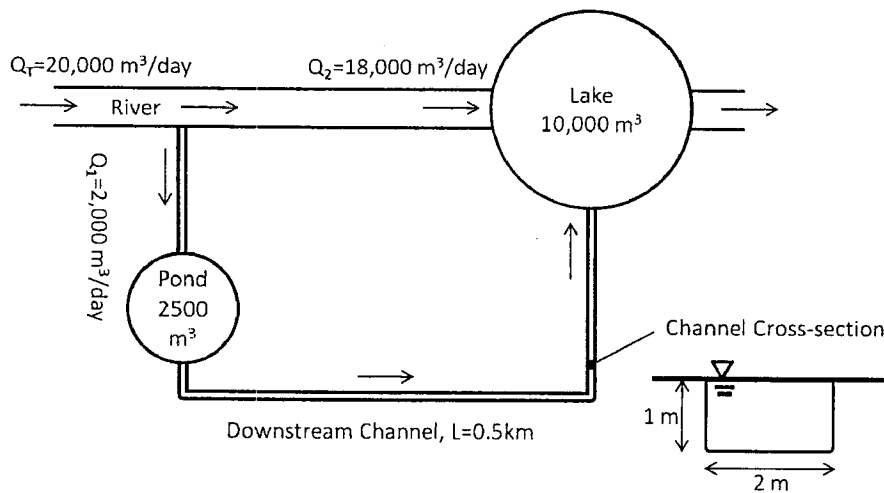
	CO <sub>2</sub> , 10 <sup>6</sup> metric tons C/yr (due to combustion)	CH <sub>4</sub> , 10 <sup>6</sup> metric tons CH <sub>4</sub> /yr (due to mining/transport)
Coal	2300	16 (due to mining)
Petroleum	2300	—
Natural Gas	900	53 (due to pipeline leakage)

3. (15%) Name three chemical disinfectants that are most widely considered as alternatives to free chlorine. Compare their advantages and disadvantages relative to free chlorine.
  
4. (15%) What are three major concerns associated with organic matter in water?

注意：背面有試題

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5. (10%) Killer whales are carnivorous (meat-eating) whale that live in arctic waters. In 1999 US ABC World News Tonight reported on television that killer whales are the most "polluted" animals on the planet. Explain why this is so, even though the arctic itself is not the most polluted water on the planet. Whales are known for their blubber (fat), what effect does this have on the "pollution" of whales?
6. (20%) 10 g conservative algaecide was instantaneously introduced into a trout hatchery pond ( $V_1=2,500 \text{ m}^3$ ) to kill and prevent the growth of algae. The pond is connected to the river and the lake through a channel, as shown in the figure. The downstream channel is 2m wide, 1 m high and 0.5 km long. Flow in the channel and the river is plug flow and the pond is assumed completely mixed. Flow in the river upstream of the diversion is  $Q_r=20,000 \text{ m}^3/\text{day}$ , and  $Q_1=2,000 \text{ m}^3/\text{day}$  is delivered through the pond. Both the river and the pond flow into a well-mixed lake ( $V_2=10,000 \text{ m}^3$ ). Derive the equation of time when the maximum concentration of algaecide occurs in the lake (you do not need to calculate the value).



參考用

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