

基礎題

1. 某一廢水水質:200 mg/L 的乙二醇( $C_2H_6O_2$ )，100 mg/L 的酚( $C_6H_6O$ )，其中假設乙二醇可被完全生物降解，而酚僅能被生物降解 60%，請問
  - (a) 請計算理論 COD。(15 分)
  - (b) 請計算最終 BOD。(15 分)
2. 一樣品之水質分析實驗的分析結果如下
  - total solids(總固體物) 4000 mg/l
  - volatile solids(揮發性固體物) 3000 mg/L
  - volatile suspended solids(揮發性懸浮固體物) 2000 mg/L
  - fixed suspended solids(固定性懸浮固體物) 1500 mg/L請問以上分析的結果何者是較為有問題的，請解釋。(10 分)
3. 在一間體積為  $50 \text{ m}^3$  的客廳放置一台煤油暖爐，在室內未抽氣的狀況下，一氧化碳排放率為  $1 \text{ g/hr}$  且室內的空氣交換率為  $1 \text{ hr}^{-1}$ 。
  - (a) 假設室外的一氧化碳濃度可忽略，請問在穩定狀態下客廳的一氧化碳濃度是多少  $\text{g/m}^3$ ? (10 分)
  - (b) 假設穩定狀態在煤油還沒燒完前已先達到。若煤油燒完後，一氧化碳濃度會呈 exponential 衰退，其一階反應衰退率為  $1 \text{ hr}^{-1}$ ，請寫出一氧化碳濃度隨時間變化的關係式。(10 分)

應用題(可中文敘述)

Part 1

For almost 200 years, humans have exploited fossil fuels as energy sources. However, the energy demand has increased drastically due to rapid industrialization and urbanization in the middle of twentieth century. The growing environmental concern with the excessive use of fossil fuels is one of the major driving forces to explore alternative energy sources. The use of fossil fuels leads to the emissions of gaseous pollutants, such as carbon dioxide, carbon monoxide, oxides of nitrogen ( $\text{NO}_x$ ), oxides of sulfur ( $\text{SO}_x$ ) and other pollutants. One of the main consequences of the emissions is the greenhouse effect, which is caused by excess carbon dioxide in the atmosphere from coal-fired power plants or automobiles. Another consideration in search of alternative energy sources is to cut down the heavy dependence of the US on imported petroleum which accounts for over 50% of the nation's energy demand (Source: US Department of Energy). Therefore, there is a pressing need for non-polluting energy alternatives, which are reliable and cost effective as well as have minimum adverse impact on the global environment. As a sustainable energy supply with minimal or zero use of hydrocarbons, hydrogen is a promising alternative to fossil fuel. The combustion product of hydrogen is a

nonpolluting - water.

1. Would you tell me what alternative energy carrier the essay is trying to point it out? (10 分)
2. Please describe why burning such fuel is environmental friendly. (10 分)

## Part 2

Scientists at the Massachusetts Institute of Technology have discovered an energy source that you can see only through a microscope. The researchers devised a process for generating electricity using nanotechnology. They plan to refine the process in hopes of creating a new environmentally friendly battery, among other products. It works like this: Researchers used tiny wires, known as carbon nanotubes, to create a powerful wave of energy, according to Michael Strano, and MIT associate professor of chemical engineering. He is also the senior author of a paper on this new phenomenon, published in this week's Nature Materials journal. After coating these tiny wires with a layer of fuel, Strano said his team generated a so-called thermopower wave and stumbled across a reaction that may eventually be used to power electronics, computers and cell phones. "This could lead to batteries that are up to 10 times smaller and still have the same power output. In the portable energy and energy conservation arena, we're trying to find power sources that have a smaller profile but hold more energy," Strano told CNN Radio. To build a power source, such as a battery, it's necessary to move electrons in a material from one end of the battery to the other, creating an electrical current. This thermopower wave MIT researchers discovered, using the class of molecules know as carbon nanotubes, does just that. Strano said "some of the advantages of this technology [are] you can generate a lot of power from a very, very small device." And that's not all. Most batteries on the market now are made from highly toxic heavy metals, which are very bad for the environment -- metals like lead, nickel and cadmium. Batteries made from this new thermopower technology would be completely nontoxic, Strano said. "The materials we use to make these thermopower waves are organic. They're not grown naturally, but they're made of carbon. In other words, you could essentially incinerate them, or they would degrade over time, there's no heavy metal residue," Strano said. There's another potential benefit in using a so-called thermopower battery: energy savings. "Most people don't realize a battery sitting unused in your laptop is leaking its power away," Strano said. "If you take all the laptop batteries that are produced in one year, in the off state, they're leaking an amount of power during that year that we could store in a small nuclear reactor ... and that's power that's essentially lost and dissipated just from laptop batteries." (Source: CNN News, March 12, 2010)

1. According to this news, please describe which new energy source was discovered by Professor Strano and his team? (10 分)
2. The researchers used some kind of tiny wires to create such energy. What is the main component of the tiny wire? (10 分)