以下五題（每題20分）係取材自 Tom Tietenberg (2003) 所著之 Environmental and Natural Resource Economics 乙書。請詳讀摘錄之短文後，說明(1)短文之主要結論及(2)短文之主要資源管理觀念。

(一)

The domestic demand for lead has changed significantly over the last 25 years. In 1972, dissipative, non-recyclable uses of lead (primarily gasoline additives, pigments in paint, and ammunition) accounted for about 30% of reported consumption. And only about 30% of all produced lead came from recycled material.

Over the last two and a half decades, however, Congressional recognition of lead's negative health effects on children have led to a series of laws limiting the amount of allowable lead in gasoline and paints. Not only has this resulted in a decline in the total amount of lead used, but the decline has been most dramatic for the dissipative uses (which, as of 1997, had fallen to only 13% of total demand). A declining role for dissipative uses implies an increasing proportion of the production is available to be recycled. And, in fact, more was. By 1997, 77% of the domestic supply of lead was being recycled.

Old scrap accounts for some 96% of the total lead scrap recovered. Used batteries supply about 90% of that old scrap. Battery manufacturers have begun entering buyback arrangements with retail outlets, both as a marketing tool for new batteries and as a means of ensuring a supply of inputs to their downstream manufacturing operations.

(二)

For years the United States and Canada had been discussing the possibility of constructing a tidal power project in the Passamaquoddy Bay between Maine and New Brunswick. This project would have heavy initial capital costs, but low operating costs which presumably would hold for a long time into the future. As part of their analysis of the situation, a complete inventory of costs and benefits was completed in 1959.

Using the same benefit and cost figures, Canada concluded that the project should not be built, while the United States concluded that it should. Because these conclusions were based on the same benefit-cost data, the differences can be attributed solely to the use of different discount rates. The United States used 2.5% while Canada used 4.125%. The higher discount rate makes the initial cost weigh much more heavily in the calculation, leading to the Canadian conclusion that the project yields a negative net benefit. Since the lower discount rate weights the lower future operating costs relatively more heavily, Americans saw the net benefit as positive.

There are a number of other examples, as well. During 1962, Congress authorized a number of water projects which had been justified by benefit-cost analysis using a discount rate of 2.63%. Upon examining these projects, economists Fox and Herfindahl (1964, p. 202) found that, at an 8% rate of discount, only 20% of the projects would have had favorable benefit cost ratios.

The choice of the discount rate even played a major role following a highly publicized dispute between President Jimmy Carter and Congress. President Carter wanted to rescind authorization from many previously approved water projects that he viewed as wasteful. The President based his conclusions on a discount rate of 6.38% while Congress was using a lower one.

Far from being an esoteric subject, the choice of the discount rate is fundamentally important in defining the role of the public sector, the types of projects undertaken, and the allocation of resources across generations.

(三) In 1975, largely in response to local groundwater pollution, Zurich instituted an excess charge that would be applied only if a customer exceeded a predefined consumption threshold. Households, for example, could consume up to 1000 litres/day at the basic price. Every unit over that threshold, however, would be charged the much higher (initially double) per unit rate.Other categories of consumers (such as commercial or industrial) faced a similar pricing system with unique thresholds and rates defined for each category.

Together with important changes in the wastewater pricing system, this rate structure seems to have made quite an impact. From 1970 to 1997, despite population increases, total water consumption in Zurich fell by 23%. (During this same period Switzerland only achieved a 1% reduction.) In Zurich the amount of "excess" water consumed (the amount over the thresholds) fell from 7.3% to 3.7% of total consumption.

(四) It is relatively common practice to estimate the number of years a given resource will last by computing what is known as the *static reserve index*, the ratio of current reserves to current consumption. The result of the calculation is supposed to be interpreted as the number of years remaining until the resource is exhausted. This is a correct calculation of the time to exhaustion if and only if: (1) the consumption of the resource remains at current levels until the time of exhaustion (it can neither increase nor decrease); and (2) no additions to the reserves occur in the intervening period (current reserves and potential reserves are assumed equal for the prices which can be expected to prevail).

These assumptions generally are not even approximately accurate. For example, in 1934 the static index for copper was 40, indicating the reserves would be exhausted in 40 years. In 1974, 40 years later, this index stood at 57. A similar calculation for crude oil, iron ore, and lead would reveal the same pattern; the static index tends to underestimate the time until exhaustion.

The *Beyond the Limits* study used an index called the *exponential reserve index*, which tends to underestimate the time to exhaustion by an even greater amount than the static index. This index assumes that consumption will grow over time at a constant rate of growth. No correction is made for additions to reserves or for the effects of higher prices on demand. It is therefore neither very surprising, nor very interesting, that their time-of-exhaustion estimates are so proximate.

(五) Since environmental problems are thought to be caused by a divergence between individual incentives and collective incentives, it is not uncommon to hear that centrally planned economies avoid environmental problems. Centralizing power in the state, as occurs in a centrally planned economy, is believed to allow collective decisions to be made at the outset.

Studies of air and water pollution in the former Soviet Union and other Eastern European countries suggest that the problems found in market economies occur with equal intensity in the Eastern block. Copsa Mica, Romania, for example, is called Europe's most polluted urban area. Weakened by acid rain, monuments in Krakow, Poland, are crumbling. Women with newborn babies in Czechoslovakia have priority access to bottled water because tap water is considered injurious to infant health.

How can this be? Goldman suggests that the centralized planning system creates different, but no less potent, divergences between individual and collective incentives. For example, as of 1970, 65% of all factories in the largest Soviet republic, the Russian Soviet Federated Socialist Republic, discharged their waste into the water without any attempt to clean it up. They did this because the managers were being judged solely in terms of output, not in terms of the harm they caused to the environment. The central plans which set the priorities to be followed by the managers very simply emphasized economic growth over the environment.

In his summary Goldman states:

> . . . not private enterprise but industrialization is the primary cause of environmental disruption. This suggests that state ownership of all the productive resources is no cure-all.