Environmental Science I

Approximately six to eight questions for applicants to demonstrate their abilities concerning fundamental problems in comprehending environment systems. The followings are examples:

Example 1

Suppose that the supply of a finite resource $S(>0)$ is provided to two individuals, *x* and *y*. Find *x* and *y* that maximize $x^{\alpha}y^{\beta}$, where α and β are positive constants.

Example 2

The half-life of radioactive iodine ^{131}I is 8.0 days. How long does it take for ^{131}I to decrease to 1% of its initial amount? Calculate in three significant digits. You may use common logarithm $\log_{10} 2 \approx 0.301$.

Example 3

Answer the following questions about the environmental standards of water pollution:

(1) Explain briefly the reason COD (chemical oxygen demand) is used as the water-pollution index for lake water instead of BOD (biological oxygen demand).

(2) Choose a water-pollution standard related to living environment other than BOD and COD, and describe in a few lines the terminological meaning of the standard and the possible environmental impact when quality of water does not meet the standard.

Example 4

Suppose that the relationship between the number of individuals *N* in a population and the intrinsic rate of increase *r* is expressed in the differential equation

$$\frac{dN}{dt} = rN \qquad \text{(a)}$$

where *t* is time.

(1) Solve equation (a), and draw a graph with *time* along the horizontal axis and *number of individuals* along the vertical axis.

(2) If the concept of carrying capacity *K* is introduced, the differential equation

$$\frac{dN}{dt} = rN\frac{K-N}{K} \qquad \text{(b)}$$

is also applicable. Explain the meaning of equation (b). Solve the equation (b), and draw a graph with *time* as the horizontal axis and *number of individuals* as the vertical axis.

Environmental Science II

Approximately two to three questions for applicants to demonstrate their abilities of analysis and interpretation in designing experiments and observations, and in dealing with phenomena and data in environmental science. See the following examples:

Example 1

Suppose you investigated the impacts on the ecosystem caused by a wind turbine installed at coastal area.

(1) Multiple monitoring sites are set in the immediate vicinity of the wind turbine and at a significant distance from the wind turbine. The investigations are carried out four times (every three months) in the year before and in the year after the wind turbine installation. Explain why such observation is designed.

(2) Population of a species A was recorded in the observations. Explain how to examine whether the installation of wind turbine significantly impacts the population of species A.

Example 2

The total volume of water on Earth is estimated to be 1.4×10^9 km^3, and freshwater constitutes 2.5%. Assume that saltwater exists only in the ocean, and also assume that the annual precipitation on the ocean is 1300 mm/year and that the annual precipitation on land is 800 mm/year. Also assume that the average evaporation from the ocean is 1400 mm/year. The radius of Earth is 6400 km, and 70% of the surface area of Earth is covered by ocean and 30% by land. Water storage in the atmosphere is negligible.

(1) Find the annual evaporation from land and the average residence time of freshwater on land.

(2) The average residence time of rivers is estimated to be about several weeks and the average residence time of lakes/swamps is estimated to be about several decades. Explain the reason that the result obtained from (1) differs so much from these values by considering the following figure.

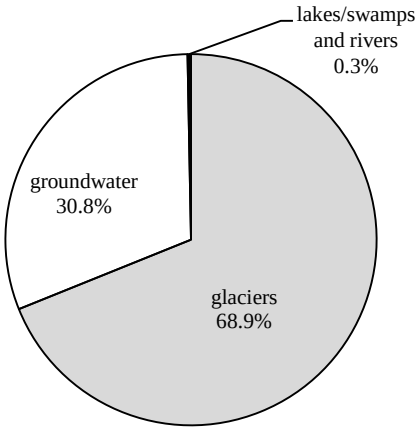

Figure: Form or freshwater on land