Application ID number:

Name:

International Master's Programs in the Graduate School of Engineering, 2025

Screening Examination Questions・Answer Sheet

Subject	Environmental System Engineering

Score

【 Q1 】 Solve the following questions（ 50 points ）

(1) Answer following questions.

1-1. Regarding the principles of sustainable development proposed by Herman Daly, which of the following combinations is correct? Choose only one from options 1 to 5.

a. The development rate of renewable resources must not exceed the pace of economic growth.
b. The consumption rate of renewable resources must not exceed their regeneration rate.
c. The development rate of non-renewable resources must not exceed the pace of economic growth.
d. The consumption rate of non-renewable resources must not exceed the pace at which sustainable renewable alternatives can be developed.
e. Pollution emissions must not exceed the environment's ability to decompose and absorb them.

Options:

1. a, b, e
2. b, d
3. b, d, e
4. a, c, e
5. a, d, e

3

1-2. In environmental systems, a solution that is optimal for a part of the system may not be optimal for the system as a whole, and may lead to unintended and unforeseen consequences. What is this phenomenon called? Choose only one from options 1 to 5.

1. Diminishing returns
2. Trilemma
3. Fallacy of composition
4. Economies of scale
5. Historical materialism

3

1-3. Which of the following statements correctly reflects the content of the Club of Rome's *"The Limits to Growth"*? Choose only one from options 1 to 5.

1. It analyzed the interrelationships of population growth, industrialization, food shortages, depletion of natural resources, and environmental degradation over a 100-year period.
2. It focused on the issue of food shortages and highlighted agricultural technologies to overcome the limits of population growth.
3. It predicted the limits of growth under capitalism and proposed a shift to socialism.
4. It described methodologies for resolving the limits to growth through market mechanisms.
5. It discussed the limits to growth based on the trends of global economic growth from ancient Rome

to the present.

1

1-4. Which of the following correctly describes the Delphi method? Choose only one from options 1 to 5.

1. A method of organizing information by writing down various pieces of information on individual labels and rearranging them.
2. A method of conducting repeated surveys with the same questionnaire to a group of people and summarizing their opinions.
3. A method of classifying elements into hierarchical levels using a reachability matrix, where upper-level elements are considered more important and lower-level elements influence them.
4. A method of creating a logic tree that systematically breaks down and organizes complex problems for problem-solving or decision-making.
5. A type of brainstorming session where participants freely generate ideas without being constrained by existing concepts.

2

1-5. Which of the following statements correctly describes the Contingent Valuation Method (CVM)? Choose only one from options 1 to 5.

1. A method that estimates environmental value indirectly from the prices of goods and services traded in the market.
2. A method that estimates environmental value by directly asking individuals their willingness to pay or accept compensation.
3. A method that estimates benefits such as reduced health damage or increased productivity from environmental improvements based on actual data.
4. A method that estimates the value of tourism resources based on the costs incurred by travelers to reach the destination.
5. A method that estimates the value of environmental factors reflected in housing prices using statistical techniques.

2

1-6. Which of the following correctly describes Commons? Choose only one from options 1 to 4.

1. Commons are resources with high excludability and low rivalry.
2. Commons are resources with low excludability and high rivalry.
3. Commons are resources with low excludability and low rivalry.
4. Commons are resources with high excludability and high rivalry.

2

1-7. Which of the following statements correctly describes carbon neutrality? Choose only one from options 1 to 5.

1. Reducing carbon dioxide emissions to zero
2. Balancing carbon dioxide emissions with carbon absorption
3. Completely replacing energy sources with renewable energy
4. Reducing greenhouse gases other than carbon dioxide
5. Replacing plastic with bioplastics

2

1-8. Briefly explain “Carrying Capacity” .

Carrying capacity refers to the maximum population size or level of human activity that an environment can support over time without being damaged.

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(2) Fill in the blanks below [①_____] ~ [⑨_____] with the most appropriate technical term, equation, sentence or value.

- Microorganisms being responsible for biological wastewater/sewage treatment is called [① activated sludge]. They show quite high settleability in settling tanks, because they can self-aggregate each other, that is, they form so-called "[② floc]".

- [③ Alkalinity] is equal to the quantity of acid required to neutralize the existed alkali in the solution. This is an important index for the natural aquatic areas where receive acid rain.

- The reason why [④ chlorine (hypochlorite)] is indispensable disinfectant under the "Water Supply Act" in Japan, is that it keeps the effectiveness until end of water supply tap and keeps the safety against contamination along water distribution.

- When substrate concentration is S, the constant is K_m, and the maximum enzyme reaction rate is V, the [⑤ Michaelis–Menten] equation as a theoretical enzyme reaction rate (v) equation is expressed: $v = V \cdot S / (K_m + S)$. In biochemistry, the equation is one of the best-known models of enzyme kinetics. It is named after German biochemist and Canadian physician.
If the substrate concentration S is much higher than the constant K_m, the enzyme reaction rate v becomes a [⑥ zero (zeroth)] order reaction. It has a rate that is independent of the substrate concentration S. Increasing the substrate concentration S will not speed up the enzyme reaction rate v.
However, if the substrate concentration S is much lower than the constant K_m, the enzyme reaction rate v becomes a [⑥ first (1st)] order reaction. It depends on the concentration of only one reactant (the substrate concentration S).
Therefore, the constant K_m means [⑦ the substrate concentration at which the reaction rate is half of the maximum enzyme reaction rate V].

- [⑧ Henry's] law states that the solubility of a gas in a liquid is directly proportional to the partial pressure of the gas above the liquid.

- The law of [⑨ heat conduction], also known as Fourier's 1st law, states that the rate of heat transfer through a material is proportional to the negative gradient in the temperature and to the area, at right angles to that gradient, through which the heat flows.