

2017年8月29日 10時～13時
10:00-13:00, August 29, 2017

B 都市工学専門 B Urban Engineering Subjects

受験番号

Examination I. D.

- (1) すべての答案用紙の所定の欄に、問題番号、受験番号を記入しなさい。氏名を記入してはならない。
Write the question number and your examination I. D. on all the answer sheets. Do not write your name.
- (2) 問題冊子に受験番号を記入しなさい。
Write your examination I. D. on this sheet.
- (3) B-1～B-15の15問の中から5問を選択し、解答しなさい。ただし、5問の解答の中で以下の条件を満たすこと。
・専攻分野として「都市環境工学」を希望するものは、B-1～B-7のうちから3問以上選択しなければならない。
・専攻分野として「都市計画」を希望するものは、B-8～B-15のうちから3問以上選択しなければならない。
Answer five questions out of the 15 questions (B-1 to B-15) following the instruction below:
・ If your major field of study is “Urban Environmental Engineering,” then select at least three questions from B-1 to B-7.
・ If your major field of study is “Urban Planning,” then select at least three questions from B-8 to B-15.
- (4) 答案用紙は1問につき1枚（裏を含む）とし、問題毎に用紙を変えなさい。
Use one answer sheet for each question. You may write your answers overleaf.

B – 1 Water and Wastewater Engineering

Question.1 Explain the terms below in words. Diagrams and formulae may be used in a supplemental manner.

- (1) Electric double layer
- (2) Effective size of filtration sand
- (3) Runoff coefficient
- (4) Sludge retention time

Question.2 Answer the questions below on ozonation of water.

- (1) In a combined process of ozonation and activated carbon treatment, ozonation is followed by activated carbon in most cases. Explain the reasons why these two processes are combined in such order.
- (2) Explain briefly the drawbacks of ozonation.

Question.3 Municipal wastewater can be considered as one of the water resources. Explain the advantages and disadvantages of municipal wastewater as a water resource over rivers and lakes.

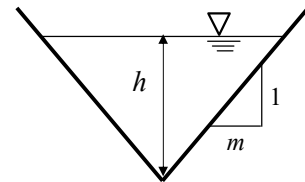
B – 2 Hydraulics

Question.1 Explain the relation and relevance between the following two terms concisely.

- 1) Conjugate depth and alternate depth
- 2) Siphon and cavitation
- 3) Froude number and wave velocity of long wave
- 4) Energy line and hydraulic grade line

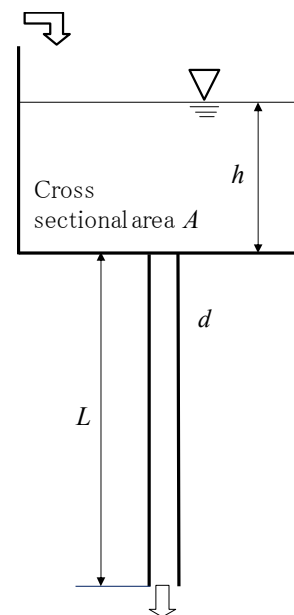
Question.2 Answer the following questions on uniform flow in a triangular cross section channel as shown in the figure below. Here, the slope gradient ratio is $1:m$ and the water depth is h .

- 1) Express the radial depth R using m and h .
- 2) Express the flow rate Q using Manning roughness coefficient n , water surface gradient i , and water depth h of channel.



Question.3 There is a water tank with a circular pipe attached to the bottom as shown in the figure below. Answer the following questions on the hydraulic phenomenon where water is being drained from the tip of the pipe. Here, the cross sectional area of the tank (A) is assumed to be sufficiently larger than the cross sectional area of the pipe, and the friction loss inside the tank is ignored, but the friction loss of the pipe and the inlet loss from the tank to the pipe are taken into consideration. The diameter and length of the pipe are d and L , respectively.

- 1) Express the water injection rate so that the water level in the tank is maintained at h . Here, friction loss coefficient of the pipe: f , inlet loss coefficient: K_e .
- 2) After adjusting the water level to h , water injection was stopped. Express the time required to drain the whole water from the outlet of the tank.



B – 3 Water Environment

Question.1 Explain the following terms concisely.

- 1) Base flow
- 2) Reaeration coefficient
- 3) Hydraulic conductivity
- 4) Octanol/water partition coefficient
- 5) n-Hexane extract

Question.2 Answer the following questions on environment of enclosed water bodies.

- 1) Explain the occurrence mechanism of blue tide and its problems.
- 2) Explain the influence of global warming on water circulation of lakes in temperate zone.
- 3) Explain how to determine the limiting nutrient for algal growth.

B – 4 Environmental Microbiology

Question.1 Concisely explain the following technical terms.

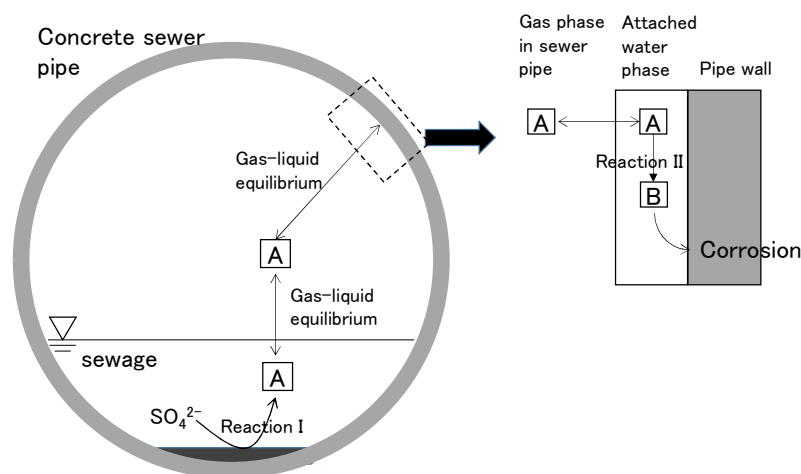
- (1) Central dogma
- (2) Genetic diversity
- (3) Competitive inhibition of an enzymatic reaction
- (4) Specific growth rate
- (5) Anaerobic digestion

Question.2 Biological wastewater treatment methods are categorized into suspended-growth processes and attached-growth (biofilm) processes. Compare the processes and summarize the pros and cons.

Question.3 The figure below shows the corrosion process of concrete sewer pipe caused by the sulfuric compounds in sewage. Reactions I and II in the figure indicate biological oxidation-reduction reactions with sulfuric compounds.

Answer the following questions.

- (1) Answer the names of sulfuric compounds for A and B in the figure.
- (2) Answer the names of microorganisms related with Reactions I and II, respectively.
- (3) Describe the oxidation-reduction half-reactions of sulfuric compounds in Reactions I and II, respectively.



B – 5 Environmental Chemistry and Reaction Kinetics

Question.1 Answer the following questions about free-energy of chemical reactions.

(1) Describe the relationship between Gibb's free energy change and equilibrium constant K .

(2) Given that the enthalpy change of a reaction is positive, explain with reasons how the equilibrium constant K changes when the reaction temperature is increased.

Question.2 Explain briefly about mechanisms of the following environmental problems.

(1) Depletion of ozone layer

(2) Concentration of contaminants by fog in the air

Question.3 Explain briefly the following terms.

(1) Freundlich isotherm

(2) Persistent organic pollutants (POPs)

(3) Temperature inversion layer of atmosphere

B – 6 Global Environmental Engineering

Question.1 The following conditions are given for a conventional vehicle (CV) which is powered by gasoline and an electric vehicle (EV) which is powered only by electricity. Here, carbon dioxide (CO₂) emissions associated with maintenance and disposal of automobiles are negligibly small compared to those from production and driving of vehicles. Answer the questions (1) and (2) with respect to life cycle CO₂ emissions (LCCO₂) of vehicles.

- Gasoline mileage (fuel economy) of a CV: 20 km/L
- CO₂ emission factor of gasoline combustion: 2.4 kg/L
- CO₂ emission intensity of gasoline production: 0.4 kg/L
- CO₂ emission associated with CV production: 4.0 t/vehicle
- CO₂ emission associated with EV production: 8.0 t/vehicle
- Lifetime travel distance of a vehicle (either CV or EV): 1.0×10^5 km

- (1) Express a relation between the electricity consumption intensity of EV driving y (in kWh/km) and the CO₂ emission intensity of power generation x (in kg/kWh) by an inequality which satisfies the condition that LCCO₂ are smaller for an EV than a CV. Furthermore, illustrate this relation on a coordinate plane in the range of $0.2 \leq x \leq 1.0$.
- (2) The inverse of y is called *electric mileage* of an EV. Let the CO₂ emission intensities of power generation be 0.1 kg/MJ and 0.2 kg/MJ in regions A and B, respectively. Indicate the condition of electric mileage (in km/kWh) which satisfies the above-determined inequality in the regions A and B, respectively. Here, the unit of CO₂ emission intensities should be converted according to the definitions of J (joule) and Wh (watt-hour).

(To be continued)

Question.2 Among the 17 goals in the Sustainable Development Goals (SDGs), 5 targets towards *mitigation* of and *adaptation* to climate change are given in Goal 13 (i.e., take urgent action to combat climate change and its impacts). Answer the questions (1) and (2) with respect to relationship between SDGs and climate change.

- (1) SDGs include several goals associated with climate change. Give two goals that are relevant to climate change *mitigation*, other than Goal 13.
- (2) With regard to one of the two goals that are given in (1), explain how it is relevant to climate change mitigation, by referring to specific targets and keywords that are mentioned in those targets.

Question.3 Explain the following terms (1) and (2) in five to ten lines, respectively, by clarifying differences among the categories.

- (1) Type I; Type II; Type III environmental labelling/declarations
- (2) Scope 1; Scope 2; Scope 3 of the GHG Protocol

B – 7 Waste Management and Material Cycles

Question.1 Answer the following questions about waste incineration.

- (1) Explain the purpose of thermal treatment of solid waste.
- (2) Answer a typical furnace which is widely used for municipal solid waste (MSW) incineration in Japan and explain its structure.
- (3) There are various facilities and equipment other than the furnace in an incineration plant for MSW. Provide three major facilities or equipment and explain their functions, respectively.

Question.2 Indicators of “recycling rate” by various definition are being used. Explain more than two combinations of numerator and denominator of the recycling rate by presenting concrete example of material or product.

Question.3 Some of the municipal solid waste and the industrial waste have been contaminated by the accident of Fukushima Daiichi Nuclear Power Stations in 2011. Provide an example of contaminated waste, and explain problems happened in their storage, recycling, treatment and disposal.

Question.4 Explain the following terms in about five lines each.

- (1) Home Appliance Recycling Law
- (2) Controlled type final disposal site

B – 8 Urban Planning

Explain briefly the difference between the development permission system in Japan and the subdivision control system in the United States of America.

B – 9 Urban Design

Question.1 Explain the following terms on urban design in about 5 lines each, with regard to their outlines, successful examples, their goals in urban design, and their contributions and challenges in actual urban space.

- (1) Courtyard housing block
- (2) Sunken garden
- (3) Urban axis
- (4) Landmark

Question.2 It is widely recognized that urban design is a “design of relationships”. Answer the following questions regarding urban design as a “design of relationships”.

(1) Discuss in about 5 lines what relationships urban design deals with and how urban design enhances them towards better urban places.

(2) Take one urban design example, either in Japan or abroad, and illustrate its strong and/or weak points from the aspect of “design of relationships”.

B – 1 0 Urban Housing

Question.1 Explain the following terms on urban housing in 5 lines or less.

- (1) Cohort method
- (2) Property tax
- (3) Building agreements
- (4) Food desert
- (5) Standard household

Question.2 Answer the following questions on the elderly housing with supportive services based on the Act on Securement of Stable Supply of Elderly Persons' Housing.

- (1) Explain necessary characteristics of the housing in view of the physical aspect and the supportive services.
- (2) Discuss problems on the location of the housing.

B – 1 1 Urban Disaster Management and Planning

Question.1 Answer the following questions on the two disasters in Japan listed below respectively.

The 1964 Niigata Earthquake

The 1978 Miyagi Earthquake

- (1) Explain the characteristics of the damage caused by the disaster in about 3 lines each.
- (2) Explain the impact of the disaster on subsequent disaster prevention plans in about 3 lines each.

Question.2 Explain the following terms in about 2 lines each.

- (1) Long period earthquake ground motion
- (2) Urban fire compartment
- (3) Normalcy bias
- (4) Local disaster management plan

B – 1 2 Urban Analysis

Question.1 Assume that beachgoers are uniformly distributed along a beach approximated by a line segment from $x=0$ to 1. No beachgoers exist outside of this segment. Each beachgoer will independently visit a shop on the beach to buy a bottle of cold drinks. The optimal allocation of shops is defined as the allocation minimizing the sum of distance between the location of each beachgoer and the closest shop. All the shops will sell bottles of cold drinks at the same price.



- (1) When the number of shop is one, derive the optimal allocation of the shop.
Describe also the derivation process.
- (2) When the number of shops is two, derive the optimal allocation of the shops.
Describe also the derivation process.
- (3) When the number of shops is n , derive the optimal allocation of the shops.
Describe also the derivation process.

Question.2 Suppose that you will conduct the questionnaire survey to ask citizens in a city regarding management of urban facilities in the long run. Describe points of attention in view of the following aspects.

- (1) How to select the respondents to conduct questionnaire survey
- (2) How to set questions of the questionnaire
- (3) How to analyze the results of the questionnaire

B – 1 3 Urban Transportation Planning

Question.1 The box below includes the findings from Japanese Nationwide Person Trip Survey conducted in 2015. Choose the most appropriate numeric values for the blanks [①]–[⑤] from the options (a)–(i).

Hint: The most appropriate values for [①]–[⑤] are all different.

The average going-out rates in weekdays and holidays are about [①] % and [②] %, respectively, and in declining trend. Roughly, the rates for the older age-groups than [③]s have increased and those for the younger have decreased, except for the Survey 2010 which showed different trends.

The [④]s male's private-purpose trip rate in holidays is lower than that of 80 and older, and the lowest among all age-groups.

The modal shares of automobile for three major metropolitan areas in weekdays and holidays are about [⑤] % and [③] %, respectively.

Options: (a) 10 (b) 20 (c) 30 (d) 40 (e) 50 (f) 60 (g) 70 (h) 80 (i) 90

Question.2 Answer the following questions on transportation planning in central districts.

- (1) Explain within three lines the characteristics and advantages of “traffic cell system”, which is known as one of basic forms of transportation plans in central districts.
- (2) Explain within five lines by using all the terms below the often-cited negative effects of the parking obligation on town planning in central districts of Japanese metropolitan cities.

[Terms] “continuity,” “standards,” “congestion,” “rebuild,” and “excess supply”

Question.3 Explain each of the following pairs of terms by paying attention to mutual relationships and/or differences.

- (1) “multimodal” and “intermodal”
- (2) “logit model” and “probit model”
- (3) “cross-sectional data” and “panel data”

B – 1 4 Regional Planning

Question.1 Choose three from the following terms related to urban and regional development and explain them in about 3 lines each.

- (a) “Spatial Cycle Model” introduced by Leo H. Klaassen
- (b) “World City Hypothesis” introduced by John Friedmann
- (c) “Business Cluster Concept” introduced by Michael Porter
- (d) “Rural-Urban Linkages” introduced by Mike Douglass
- (e) “Creative Class Concept” introduced by Richard Florida

Question.2 Answer the following questions on the concentration of population and various functions to Tokyo.

- (1) Describe in about five lines major changes of population flows to/from Tokyo metropolitan region since 1950s, in comparison with other metropolitan regions in Japan.
- (2) Choose a correct term for cities designated by the Multi-Polar Patterns National Land Formation Promotion Act (Act No. 83 of 1988), in order to disperse functions from city centers of Tokyo metropolitan region.
 - (a) new industrial cities (shin-sangyo-toshi)
 - (b) ordinance-designated cities (seirei-shitei-toshi)
 - (c) business core cities (gyomu-kaku-toshi)
 - (d) collaborative core cities (renkei-chusu-toshi)
- (3) Choose one facility from the following four, whose relocation from the central Tokyo is recently discussed while the location was formerly restricted along with factories by the Law for Restriction of Locations of Factories and some other Functions in Built-Up Areas of the Capital Region (Act No.17 of 1959, abolished in 2002) .
 - (a) housing complex
 - (b) office building
 - (c) commercial facility
 - (d) university
- (4) Discuss in about five lines a problem in Tokyo metropolitan region, which may become worsened in the next 10 to 20 years by the concentration of population to the region until now.

B – 1 5 Landscape Planning and Environmental Design

Question.1 How should parks and open space be developed and maintained in a shrinking city where decreasing and aging population and a tight budget are expected?

Answer in approximately 100 words by considering the partial revisions of Urban Park Act and Urban Green Space Conservation Act in 2017 as follows.

■ Partial revision of Urban Park Act (2017)

A legislative system, which encourages commercial enterprises to have business activities for park users, e.g. coffee shops and restaurants in a park, has been enforced.

■ Partial revision of Urban Green Space Conservation Act (2017)

Favorable tax treatments and/or financial incentives may be applied if a privately maintained land is used as a green space opened to the public.

Question.2 When farmlands are remaining in the urban area of a shrinking city, how should they be conserved in conjunction with the measures on parks and open space?

Answer in approximately 70 words.