Question 1. (Compulsory)

Explain each of the following 20 keywords related to environmental design. (5 points × 20 questions)

(1) Landscape Act in Japan

(2) Allowable compressive stress for steel

(3) Postmodernism

(4) Personal space

(5) Satoyama conservation

(6) Total institution

(7) Stainless steel

(8) Marine pollutant

(9) Plane (tool)

(10) Renewable energy

(11) Art nouveau

(12) Heat transmission coefficient

(13) *The Image of the City*

(14) Building construction and construction method

(15) Tsubo-niwa (courtyard garden)

(16) Resilience

(17) Western architectural styles

(18) Kenzo Tange

(19) Green infrastructure

(20) WBGT (Wet Bulb Globe Temperature)

* Select and answer <u>two questions</u> from Question 2 to Question 5. If you answer three or more questions, your answers will not be marked.

* When answering the questions, use a separate answer sheet for each question. Each answer should be on a single sheet. The first question of your choice must be answered on the third sheet and the second question on the fourth sheet of the Answer Sheets.

Question 2. Answer the following questions on Structural Engineering.

Regarding the simple supported beam shown in the figure below, answer (1) through (4). The moment of inertia of area of the beam is I, the section modulus is Z, and the Young's modulus of the material used is E.
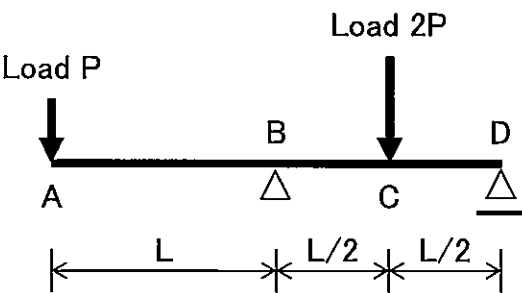
(1) Calculate the support reactions. (10 points)

(2) Calculate the shearing force and bending moment, and then draw the shearing force and bending moment diagrams. (20 points)

(3) Calculate the maximum value of the concentrated load P that satisfies $\sigma \leq f$. Note that σ is the bending stress and f is the bending strength. (10 points)

(4) Calculate the vertical displacement at point A. In the calculation, only bending deformation is considered. (10 points)

Question 3. Answer the following questions on Building Materials.

(1) The following is part of a table of specified mix proportion of concrete formulations. Find (a) through (e) obtained from this table. Make sure that you write the formulas and units. (a) and (c) should be indicated by two significant digits, (b) by four significant digits, and (d) and (e) by three significant digits. (15 points)

Specified Mix Proportion Table

(Aggregate is in surface dry condition, water absorption of aggregate does not need to be taken into account)

Unit water volume [kg/m³]	Absolute volume [L/m³]			Mass [kg/m³]		
	Cement Vc	Sand aggregate Vs	Coarse aggregate Vg	Cement Gc	Sand aggregate Gs	Coarse aggregate Gg
179	94	292	391	297	759	1056

(a)   Water cement ratio

(b)   Unit volumetric mass of concrete after mixing

(c)   Air content of concrete

(d)   Density of cement

(e)   Sand aggregate ratio

(2) Describe the creep deformation of wood, giving an overview of creep and the effect of moisture content. (15 points)

(3) Explain the relationship between carbon content and the mechanical properties of steel, including the changes related to yield point, tensile strength, hardness, elongation, and drawing as a function of carbon content. Diagrams may be used. (20 points)

Question 4. Answer the following questions on Environmental Engineering.

(1) The figure below is a conceptual diagram of Pitot tubes that are used to measure the velocity of flow. Explain the physical quantity to be measured in A and B, and then explain the principle of the measurement. (15 points)
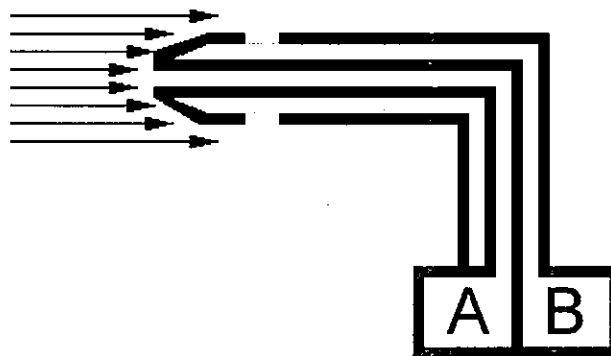
(2) There is a single wall consisting only of reinforced concrete (heat transfer coefficient of reinforced concrete λ is 1.5 $W \cdot m^{-1} \cdot K^{-1}$) without insulation. Calculate the thickness required for the thermal transmittance of this single wall to be less than 0.5 $W \cdot m^{-2} \cdot K^{-1}$. Here, total heat transfer coefficient of indoor side α_i is 10.0 $W \cdot m^{-2} \cdot K^{-1}$ and total heat transfer coefficient of outdoor side α_i is 10.0 $W \cdot m^{-2} \cdot K^{-1}$. (15 points)

(3) Explain the role of "double skin" in solar radiation control. Diagrams may be used in the explanation. (10 points)

(4) Explain "noise level [dB(A)]" using terms such as "Weber-Fechner law" and "leveling". (10 points)

Question 5. Answer the following questions on Environmental Chemistry.

(1) Explain the definition of carbon neutrality and what actions are being taken to achieve it in the world. (20 points)

(2) There are various substances that cause allergies in the indoor environment. Explain what kind of substances there are and how we can solve this problem. (15 points)

(3) How can artificial intelligence (AI) be used in the field of environmental chemistry regarding environmental pollutants and alternative fuels. Describe your thoughts as specifically as possible. (15 points)