

2025 Master's Program, Graduate School of Design (General Entrance Examination) Achievement Test
Question and Answer Sheets

Acoustic Environment Assessment

Examinee's number

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Question I (30 points)

Answer the following questions about subjective loudness.

- (1) Loudness is a measure of the subjective loudness of a sound. Explain the 'scale level', 'relationship with physical quantities of sound' and 'units' in relation to loudness. Describe the 'relationship with physical quantities of sound' using equations.

<Answer>

Example of answer:

• Scale level : Ratio scale

• Relationship with physical quantities of sound :

The loudness of the sound follows a power function of the sound intensity. $S=kI^m$

S : Loudness, I : Sound intensity, k : Constant

m : Exponent for the loudness of sound (0.3)

• Unit : sone

- (2) Another measure of the subjective loudness of a sound is loudness level. Explain the 'scale level', 'relationship with physical quantities of sound' and 'units' in relation to the loudness level.

<Answer>

Example of answer:

• Scale level : Ordinal scale

• Relationship with physical quantities of sound :

The loudness of a given sound is expressed in terms of the sound pressure level of a 1 kHz pure tone that sounds the same loudness.

• Unit : phon

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Question I (Continued from previous page)

- (3) A formula for estimating subjective loudness has been proposed and internationally standardized as ISO 532. This ISO 532 was revised in 2017 and the Moore-Glasberg method was newly adopted in addition to the Zwicker method, which is a conventional method. Explain the characteristics of the calculation method using this Moore-Glasberg method (aspects that are different from the conventional method).

<Answer>

Intent of the question:

This question is designed to assess the examinees' correct understanding of, and ability to discuss, psychoacoustics knowledge, particularly loudness. Answers are expected to include the descriptions of the characteristics of auditory filters and binaural loudness, etc.

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Question II (50 points)

Answer the following questions about the concept of soundscape, which was proposed by Canadian composer R. Murray Schafer.

(1) Answer the terms that fit to the underlined parts (A) to (E) in the following texts, which describe the characteristics of the concept of soundscape.

- One of the characteristics of the soundscape concept is that it is based on a (A)_____ view of the environment. In contrast, the sound environment has traditionally been considered based on a (B)_____ view of the environment.
- Schafer proposed the classification of sounds that people perceive in a sound environment, based on a (A)_____ view of the environment, as '(C)_____' and sounds that are perceived simply as acoustic objects as '(D)_____'.
(D)
- Schafer emphasized the act of 'listening' to sound and proposed various educational programs known as '(E)_____'.
(E)

<Answer>

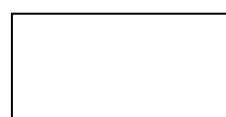
(A) semantic

(B) mechanistic

(C) sound event

(D) sounding body

(E) ear cleaning



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Question II (Continued from previous page)

- (2) In analyzing the characteristics of soundscapes, Schafer classified environmental sounds into three major categories. Give the names of the three classifications (categories), the sound characteristics of each and specific examples.

<Answer>

Intent of the question:

This question is designed to assess whether examinees understand Schafer's proposed methods for evaluating and analyzing soundscapes, and summarize and discuss them adequately. The three categories and their associated familiar sounds should be described.

- (3) In Japan, the Ministry of the Environment (the Environment Agency in 1996 when the project was implemented) conducted a project to select “100 Soundscapes of Japan: Preserving Our Heritage” by public solicitation. Answer the purpose (intent) of this project, and to which of the three categories in question (2) above the selected sound corresponds.

<Answer>

Intent of the question:

This question requires an in-depth understanding of the relevance of the concept of soundscape to Japanese environmental policies. Examinees should be able to answer this question if they have sufficient knowledge regarding Question II(2).

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Question III (20 points)

Answer the terms that apply to the underlined parts (a) to (j) of the following description of the Environmental Quality Standards for Noise in Japan. Note that for (a) answer the name of the law and for (i) answer the term used in statistics.

- The Environmental Quality Standards for Noise are based on the provisions of (a)_____ and set standards for environmental conditions related to noise that should be maintained in order to protect (b)_____ and contribute to the protection of (c)_____ .
- The current Environmental Quality Standards for Noise use (d)_____ as a noise evaluation index, with standard values defined for each area type and (e)_____ .
- A distinction is made between general areas and (f)_____ , with reference values for each.
- The previous Environmental Quality Standards for Noise used (g)_____ as a noise evaluation index. This (g)_____ is derived from the (h)_____ curve of the measured level data.
- The (i)_____ of this (h)_____ curve corresponds to (g)_____ . The upper value of the 90 % range of this curve is called (j)_____ and is used to evaluate fluctuating noise.

<Answer>

(a) Basic Act on the Environment

(b) living environment

(c) human health

(d) Equivalent continuous A-weighted SPL

(e) time zone

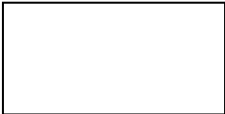
(f) road-facing areas

(g) 50th percentile level

(h) cumulative frequency

(i) median

(j) 5th percentile level



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Question IV (30 points)

Each of the following sentences about the basic acoustical phenomena and evaluation has an error. Point out the incorrect part and provide its corrected version.

(1) Concerning a plane wave with a frequency of 250 Hz and an effective sound pressure of 2 Pa, its wavelength is 1.36 m and its sound pressure level is 94 dB. The speed of sound is 340 m/s.

<Answer>

100 dB is correct, not 94 dB.

(2) Sound intensity level L_i [dB] is defined as 10 times the logarithm of the ratio of the sound intensity, namely the sound energy passing through a unit area (1 m^2) perpendicular to the direction of sound propagation per unit of time (1 s), to the reference sound energy density $E_0 = 2.94 \times 10^{-15} \text{ [J/m}^3\text{]}$.

<Answer>

The reference is not the sound energy density, but the reference sound intensity, which is defined as $I_0 = 10^{-12} \text{ [W/m}^2\text{]}$.

(3) The sound power level is the square of the ratio of the sound power radiated from the sound source to the reference sound power, and expressed as a level.

<Answer>

Squaring is incorrect. The correct answer is to express as the level of the ratio of the sound power radiated from the sound source to the reference sound power.

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Question IV (Continued from previous page)

(4) Regarding the international standard of frequency analysis in sound level meter, the relationship between the lower and upper frequencies of the octave band filter (f_1 and f_2 , respectively) and center frequency f_m is expressed as following, $f_m = 1/(f_1 + f_2)$.

<Answer>

The relation equation is incorrect.

The correct expression is not $f_m = 1/(f_1 + f_2)$, but it is expressed as $f_m = \sqrt{f_1 f_2}$.

(5) The sound exposure level is a quantity used to evaluate the total energetic content of fluctuating noise for a time range T . It is the square of the A-weighted sound pressure averaged over time range T , normalized by a reference time, and expressed as a level.

<Answer>

Averaging over time range T is incorrect; integrating over time T is correct.

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Question V (25 points)

Explain the principle of determining the sound power level L_W [dB] of the sound source whose sound power is W [W] by the following equation. The symbols in the equation must also be explained. In addition, explain in what cases the constant on the right side becomes 8 instead of 11.

$$L_W = L_p + 20 \log_{10} r + 11$$

<Answer>

Intent of the question:

This question is designed to assess whether examinees have a correct understanding of the relationship between the sound pressure level L_p [dB] and the source power level L_W [dB] at a point r [m] away an omnidirectional point source in a free field, as a basic knowledge of acoustics in general. If the examinee also has a correct understanding of the relationship in case of hemi-free field sound propagation, they can explain the difference in case the constant the right side becomes 8 instead of 11.

The answers to this question must provide accurate explanations of the quantity symbols used in the given equation and the discussion of the answer, as well as the accuracy of the discussion.

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Question VI (25 points)

Answer the following questions about sharpness, which is one of the sound quality metrics.

- (1) Describe what kind of psychological property sharpness is, and what kind of impression a sound with high sharpness gives.

<Answer>

Intent of the question:

This question is designed to assess whether the examinees have a correct understanding of the psychological property and subjective impression of sharpness, one of the sound quality metrics, and to be able to give a concise explanation of it.

- (2) Explain what acoustic characteristics affect sharpness in the case of broad band noise and harmonic complex tones.

<Answer>

Intent of the question:

This question is designed to assess whether the examinees have a correct understanding of the sharpness with regard to the frequency characteristics of broad band noise and harmonic complex tones, and to be able to give a concise explanation of it.

- (3) Zwicker proposed the sharpness model as follows. Describe what $N'(z)$ and z in the equation mean respectively.

$$S = \frac{0.11 \int_0^{24} N'(z) g(z) z dz}{\int_0^{24} N'(z) dz}$$

<Answer>

$N'(z)$ is the loudness per critical band, where z indicates the critical band number.

- (4) Answer the unit of sharpness proposed by Zwicker.

<Answer>

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Question VII (20 points)

The three attributes of sound mean the three subjective aspects of sound: "loudness," "pitch," and "timbre." Among these three, discuss the characteristic of the property of "timbre" by comparing it with "magnitude" and "pitch". The description should include three perspectives: the "multidimensionality of timbre", "relationship between timbre and physical quantities", and the "duality of timbre".

<Answer>

Intent of the question:

This question is designed to assess whether the examinees have a correct understanding of timbre, as one of the three attributes of sound, its multidimensional psychological nature, its complex correspondence with physical quantities, and the two aspects of timbre (namely impressionistic and discriminative), and to be able to discuss them appropriately using specific examples.

