2024 Master's Program, Graduate School of Design (General Entrance Examination) Achievement Test
Question and Answer Sheets

Acoustic Environment Evaluation

Examinee's number

Question I (20 points)

Answer the terms that apply to parts (1) through (10) of the following descriptions of the Basic Act on the Environment and the Noise Regulation Act as set forth in Japan.

- The Basic Act on the Environment defines "(1)_____" as the standard for sound that should be maintained in order to preserve (2)_____ and contribute to the protection of (3)_____ .
- In "(1)_____", (4)_____ is used as a noise evaluation index, and standard values are set for each regional category and (5)_____ .
- On the other hand, the Noise Regulation Act is a law that sets the standards to regulate the noise generated from factories, offices, construction works, automobiles, etc. For example, the law stipulates "(6)_____" and "(7)_____" for automobile noise.
- In the evaluation of noise according to the Noise Regulation Act, the evaluation index used differs depending on the physical characteristics of the noise. When the noise fluctuation is small, the value indicated by the sound level meter is used as it is. When the noise is periodic (or intermittent) and (8)_____ of the indicated values is approximately constant, (9)_____ of (8)_____ is used. If the noise is periodic (or intermittent) and (8)_____ of the indicated values is not constant, (10)_____ of the measured values shall be used as the evaluation index. This (10)_____ is also used in the evaluation of noise where the readings of the sound level meter fluctuate irregularly and significantly.

<Answer>

(1)_____ (2)_____

(3)_____ (4)_____

(5)_____ (6)_____

(7)_____ (8)_____

(9)_____ (10)_____

Do not write on the back side of the answer sheet, or your answers will not be marked.

Question II (20 points)

S. S. Stevens (1957) showed that the relationship between loudness and a physical quantity follows a power law. For the 1-kHz pure tone, under the power law, loudness increases by a factor of 2 with a 10 dB increase in sound pressure level. Calculate the power exponent of the relationship between loudness and a physical quantity for the 1-kHz pure tone. Also show the process of derivation.

<Answer>

Question III (20 points)

Answer the following questions regarding frequency analysis of sound (octave band analysis, 1/3 octave band analysis) using an octave band analyzer.

(1) Show the relationship between the lower and upper frequencies (f_1 and f_2) of the octave band filter used in octave band analysis, and the relationship between these and the center frequency f_c, respectively, using mathematical expressions.

<Answer>

(2) Show the relationship between the lower and upper frequencies (f_1 and f_2) of the 1/3-octave band filter used in 1/3-octave band analysis, and the relationship between these and the center frequency f_c, respectively, using mathematical expressions.

<Answer>

(3) Noise was measured at the boundary of a factory site and frequency analysis (octave band analysis) was performed. The center frequency of the octave band filter used for the analysis was 31.5 Hz to 8 kHz. Table III-1 shows the measured sound pressure levels for each band. From these measured values, determine the overall noise level (A-weighted sound pressure level) of the noise. You may use the A-weighted correction value for each octave band center frequency shown in Table III-2 and the approximate correction value when adding two dB values shown in Table III-3. The process of calculation should also be indicated in your answer.

Question III (Continued from previous page)

Table III-1 Results of octave band analysis of measured noise (sound pressure levels for each octave band)

	Octave band center frequency f_c [Hz]								
	31.5	63	125	250	500	1k	2k	4k	8k
Measured sound pressure level [dB]	62	72	68	61	69	63	60	56	46

Table III-2 A-weighted correction value at each octave band center frequency

	Octave band center frequency f_c [Hz]								
	31.5	63	125	250	500	1k	2k	4k	8k
A-weighted correction value [dB]	-39	-26	-16	-9	-3	0	+1	+1	-1

表 III-3 Approximate correction value when adding two dB values (L_1, L_2)

	Difference between two dB values L_1 and L_2 (L_1-L_2) [dB]			
	0–1	2–4	5–9	10–15
Approximate correction value [dB]	+3	+2	+1	+0

<Answer>

Question IV (40 points)

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

(1) Answer the definition of soundscape.

<Answer>

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

<Answer>

Question V (25 points)

Read the following text and answer the following questions.

It is difficult to directly measure the impressions we perceive as differences in timbre. At the same time, however, we use various adjectives to describe the impression we get from a sound, such as "bright," "dark," "soft," "hard," and so on. The < A > aspect of timbre is thus the property of being able to describe the psychological characteristics of timbre with adjectives. Since the 1960s, many studies have been conducted to summarize various adjectives describing impression of timbre using the SD method and < B >, and it has been shown that the adjectives can be summarized into three or four independent factors. Typical factors are called as [C].

(1) Answer the term that apply to part < A >.

<Answer>

(2) Answer the name of multivariate analysis method to summarize various timbre description words that apply to part < B >.

<Answer>

(3) Describe the method < B > using the following terms.

semantic space, adjective scales, latent factor

<Answer>

(4) Answer names of the 3 typical factors of timbre that apply to [C] in the text.

<Answer>

Question VI (30 points)

Fluctuation strength and roughness are the sound quality metrics which are used as indicators of the sensation obtained from sounds that periodically fluctuate in amplitude or frequency. Explain the difference between the fluctuation strength and roughness, focusing on the correspondence with the modulation frequency (frequency of periodic fluctuation).

<Answer>

Question VII (15 points)

Answer the acoustic terms defined by the following sentences.

"A quantity defined as ten times the logarithm to the base 10 of the ratio of the sound energy P to the reference power P_0, where P is given as the total acoustic energy radiated by a source per unit time within a specified frequency band".

(1) What is the acoustic term defined by these sentences?

<Answer>

(2) What is the unit of quantity indicated by this term?

<Answer>

(3) Describe the definition equation using P and P_0.

<Answer>

Question VIII (30 points)

Sound exposure level $L_{EA,T}$ is a quantity to evaluate the total energetic amount of variable noise at a certain evaluation time T (time t_1 to t_2). Explain the definition of this evaluation quantity using the defining equation. Also explain how it differs from the single event noise exposure level L_{EA}. Denote the A-weighted effective sound pressure as $p_{Ae}(t)$ [Pa], the reference sound pressure as p_0, and the reference time (1 s) as T_0.

<Answer>