2023 Master's Program, Graduate School of Design (General Entrance Examination) Achievement Test
Question and Answer Sheets

Acoustic Environment Assessments

Examinee's number

Question I (20 points)

Answer the terms that apply to parts (a) through (j) of the following explanations of the "Environmental Quality Standards for Noise" in Japan. For (a), give the name of the appropriate law.

- The "Environmental Quality Standards for Noise" is based on the provisions of (a)_____ , and is established as standards that should be maintained for environmental conditions related to noise in order to preserve (b)_____ and contribute to the protection of (c)_____ .

- (d)_____ is used as the metric in the current "Environmental Quality Standards for Noise", and standard values are set for each (d)_____ and time category.

- When measuring (d)_____ , use a sound level meter that meets the conditions specified in the Measurement Act, and use the (f)_____ for the frequency correction circuit.

- In addition to the above environmental quality standards, there are other such standards for (g)_____ noise and (h)_____ noise.

- The "Environmental Quality Standards for (g)_____ Noise" was revised in 2007, and (j)_____ was adopted as the metric to replace (i)_____ , which had been used until then.

<Answer>

(a)_____ (b)_____

(c)_____ (d)_____

(e)_____ (f)_____

(g)_____ (h)_____

(i)_____ (j)_____

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

Question II (30 points)

Loudness is a metric that expresses the subjectively perceived intensity of sound. Answer the following questions about this metric.

(1) Show an equation that expresses the relationship between perceived loudness and a physical quantity. You must also explain the symbols used in the equation.

<Answer>

(2) A related metric is the loudness level (the level of loudness of sound). Derive an equation that expresses the relationship between loudness and loudness level for a pure tone at 1 kHz from the formula in (1). In your answer, show the process of derivation.

<Answer>

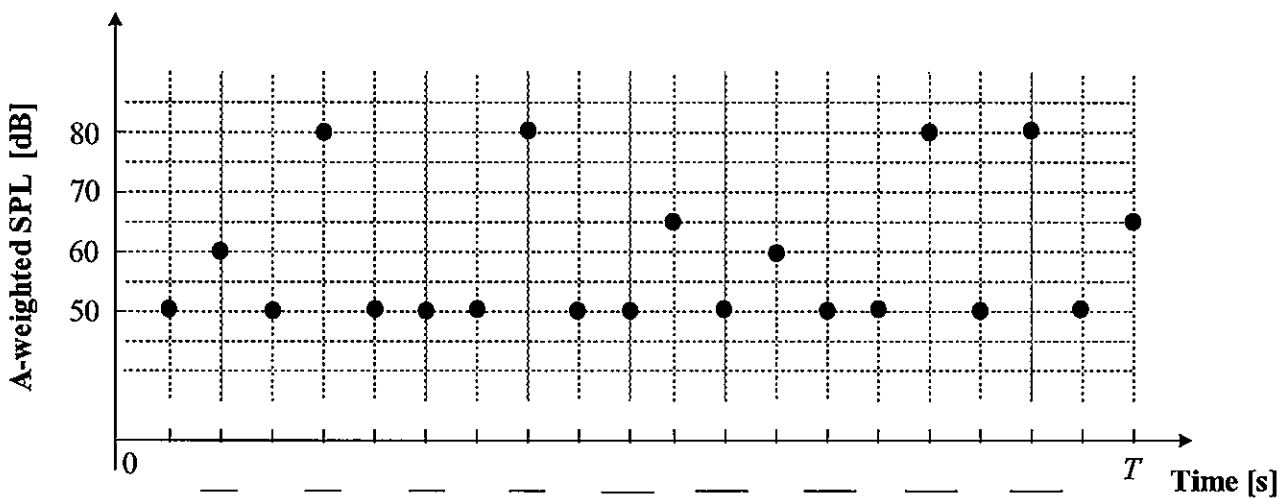
Question II (Continued)

(3) A model (formula) for estimating perceived loudness from physical quantities of sound has been proposed and standardized as an international standard ISO532. In addition to the formula in (1), this calculation model takes into account various characteristics related to human auditory information processing. List three characteristics related to human auditory information processing that are taken into account in the loudness calculation model.

<Answer>

Question III (30 points)

The figure below shows measurement results of the A-weighted sound pressure level of the noise (noise level) from time 0 [s] to T [s]. From these results, show the noise assessment amount of (1) − (4) numerically. In addition, answer question (5). However, it is not necessary to show the result in numerical values for question (5). If it is necessary to obtain the sum of the decibel values in (1) through (4), $\log_{10}2 \fallingdotseq 0.3$ and the approximate values in the table below may be used.



Approximate sum of decibel values

Difference in level [dB]	0～1	2～4	5～9	10～
Increase in level [dB]	3	2	1	0

(1) $L_{A5,T}$

(2) $L_{A50,T}$

(3) $L_{A95,T}$

(4) $L_{Aeq,T}$

(5) Explain how it is appropriate to treat this noise when evaluating it according to the Noise Regulation Law.

<Answer>

(1) $L_{A5,T}$ =

(2) $L_{A50,T}$ =

Question III (Continued)

<Answer>

(3) $L_{A95,T}$ =

(4) $L_{Aeq,T}$=

(5)

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

Question IV (40 points)

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

(1) In analyzing the characteristics of soundscapes, Schafer proposed classifying environmental sounds into three categories. Give the name of each category. In addition, describe what characteristics each sound has.

<Answer>

Question IV (Continued)

(2) Schafer stated that sounds in a soundscape could be classified into two categories. Give the name of each category in this taxonomy, which differs from (1). In addition, describe what characteristics each sound has.

<Answer>

Question V (20 points)

S.S. Stevens proposed four levels as a measure to quantify human sensation. Explain the names of the four scale levels and the properties of each scale level with actual examples.

<Answer>

Question VI (15 points)

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

(1) Answer the unit of sharpness proposed by Zwicker.

<Answer>

(2) Describe the characteristics of psychological property sharpness and the details of the impression of a sound with high sharpness.

<Answer>

(3) Explain the relationship between the spectral envelope and sharpness of the broad-band noise with the linear frequency spectral envelope.

<Answer>

Question VII (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.

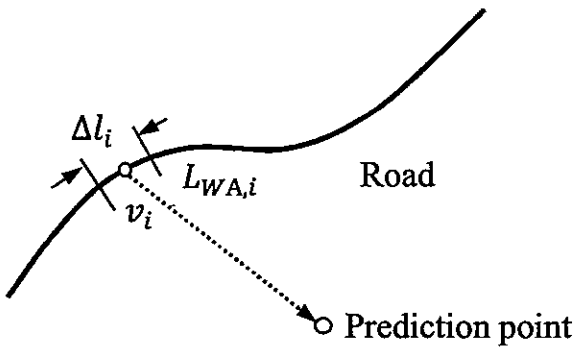
$$L_W = L_p + 20\log_{10} r + 11$$

<Answer>

Question VIII (20 points)

Answer the following questions regarding the "ASJ RTN-Model 2018," the road traffic noise prediction model proposed by the Acoustical Society of Japan.

(1) In the prediction calculation of road traffic noise, the basic procedure is to obtain the time history of A-weighted sound pressure level L_A observed at a prediction point (the unit pattern) for a single vehicle that can be regarded as an omnidirectional point source passing along the road under consideration, and to calculate the single-event sound exposure level L_{EA} for the single vehicle. Explain how to obtain the single event sound exposure level of the unit pattern, where Δl_i [m] is the length of the section i, when the road under consideration is divided into several sections, as shown in the figure. Here, the running speed v_i [m/s] and the A-weighted sound power level $L_{WA,i}$ [dB] of the running vehicle at the divided section should be regarded as constant.



<Answer>

Question VIII (Continued)

(2) When a single vehicle (light vehicle) passes at a constant speed on a flat straight road without acoustical obstructions in the vicinity, the unit pattern at a point 10 m away from the lane gives the single-event sound exposure level of 75.3 dB. Find the equivalent contentious A-weighted sound pressure level for 1 hour ($L_{Aeq,1h}$) for 900 light vehicles passing in one hour.

<Answer>

(3) Under the above assumptions, explain how the equivalent contentious A-weighted sound pressure level for 1 hour ($L_{Aeq,1h}$) changes when the number of passing light vehicles doubles or triples.

<Answer>