

Lab 7 solutions

Part I

- 1) $I = I_0 10^{(70 \text{ dB}/10 \text{ dB})} = 10^{-12} \text{ W/m}^2 \times 10^7 = 10^{-5} \text{ W/m}^2$
- 2) $\Delta \text{SIL} = 10 \log(10) \text{ dB} = 10 \times 1 \text{ dB} = 10 \text{ dB}$
- 3) $\text{SIL}_{10} = \text{SIL}_1 + \Delta \text{SIL} = 75 \text{ dB} + 10 \text{ dB} = 85 \text{ dB}$
- 4) $\text{SIL} = 10 \log(I/I_0) = 10 \log(1/10^{-12}) = 120 \text{ dB}$

Part II

- 1) $\text{SIL}(40 \text{ phon}, 200 \text{ Hz}) = 53 \text{ dB}$
- 2) $\text{SIL}(40 \text{ phon}, 4000 \text{ Hz}) = 35 \text{ dB}$

Part III

- 1) $\Delta \text{SIL} = 10 \log(1.25) \text{ dB} = 10 \times 0.097 \text{ dB} \sim 1 \text{ dB}$
- 2) $\text{JND}(80 \text{ dB}, 1000 \text{ Hz}) = 0.35 \text{ dB}$
- 3) Expect a smaller JND in intensity for the square wave since it has higher frequency components, and JND in intensity decreases with increasing frequency (ear is more sensitive to higher frequencies).

Part IV

- 1) $\text{JND}(200 \text{ Hz}) = 2.5 \text{ Hz}$ or $2.5/200 = 1.25\%$
- 2) $\text{JND}(2000 \text{ Hz}) = 10 \text{ Hz}$ or $10/2000 = 0.5\%$

Part V

- 1) $83 \text{ phon} - 73 \text{ phon} = 10 \text{ phon}$
- 2) $90 \text{ phon} - 60 \text{ phon} = 30 \text{ phon} \rightarrow 2^3 = 8 \text{ times louder}$