

Signals, systems, acoustics and the ear: Coursework I

Do all of the following problems. You may use Excel to do your calculations and any graphs, but **ensure that all graphs are fully labeled!** Handwriting is fine but must be legible. You may discuss these questions together, but please write your answers by yourself. **Show your work!**

1) Sketch 4 cycles of an electrical sine wave with a peak amplitude of 0.2 V and a period of 4 ms. What is its period in seconds? What is its frequency, in Hz and kHz? **10 points total**

2) Suppose you were told that someone had a hearing loss of 20 dB at 125 Hz, and that the normal threshold of hearing was 633 μPa at that frequency. What sound pressure (μPa) would be the least intense that person could hear at 125 Hz? What is the normal threshold of hearing at 125 Hz in dB SPL? **10 points total**

3) If some ear plugs reduced the amplitude of sound outside the ear by a factor of 3 (i.e. so that the pressure became only one-third as large), what would be the level, in dB SPL and μPa , inside the ear canal given an external noise level of 110 dB SPL? **(10 Points total)**

4) How many signals and systems can you identify in a public address (PA) system, as used for example, in a race track so that an announcer's comments can be heard by all there? Delineate these, their input and output signals, and say which of the systems is a transducer. **20 points**

5) Fill in the missing entries in the following table so as to make each row consistent. The first is done for you as an example **(10 Points total)**

| period (ms) | period (s) | frequency (Hz) | frequency (kHz) |
|-------------|------------|----------------|-----------------|
| 1 | 0.001 | 1000 | 1 |
| | | | 10 |
| | | 250 | |
| | | | 2 |
| | 0.005 | | |
| | | 400 | |
| 100 | | | |
| | .0065 | | |
| | | | 0.3 |
| | | 1 | |
| | | | 0.05 |

6) Convert the following values into dB SPL **(10 Points total)**:

5 μPa 1 Pa 10 Pa 0.06 Pa 15 μPa

7) Convert the following values into μPa **(10 Points total)**:

0 dB SPL 25 dB SPL 114 dB SPL -10 dB SPL 6 dB SPL