Acoustics and electroacoustics

Exercise 1

A 'shoe-box' room has the following dimensions:

- length 50m
- width 20m
- height 8m.

1st question : what is the minimum surface of absorbing material to be installed on the wall such that the reverberation time is less than
1.5s at 250 Hz
1s at 1 kHz
0.7s at 4 kHz ?

Note : the absorption coefficients of the absorbing material are given in the table below.

2nd question : with the surface of absorbing material found in (1), what is the decrease of the sound pressure level (SPL) at 1 kHz as a function of the distance to the source (source power 100 dB at 1 kHz, Q=1) ?
The contributions of the direct and reflected fields must be highlighted on the plotted curve.

Remarks :

- air absorption can be neglected
- c=340 m/s

Data

Frequency (Hz)	250	1000	4000
alpha ceiling	0.5	0.7	0.7
alpha uncovered walls	0.2	0.2	0.3
alpha floor	0.1	0.2	0.3
alpha absorbing material (on the wall)	0.5	0.7	0.9

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Exercise 2

A small theatre ('shoe-box shape') has the following dimensions :

- length 20m
- width 10m
- height 5m.

The following reverberation times (RT) have been measured :

Frequency (Hz)	125	250	500	1000	2000	4000
RT (sec)	1.5	1.4	1.2	1.0	0.9	0.6

1st question : at which distance from the source are the listeners in the 'direct field' ?

2nd question : for the listeners who are in the 'reflected field', what is the SPL (**in dBA**), if the acoustic power of an actor is given by the power level (PWL) in the table below:

Fréquence (Hz)	125	250	500	1000	2000	4000
PWL (dB)	80	80	75	70	70	60

Remarks :

- air absorption can be neglected
- c=340 m/s

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Exercise 3

An office has a 'shoe-box' shape with the following dimensions:

- length 20m
- width 20m
- height 4m.

The absorption coefficients of all surfaces are given in the table 1 below.

Question :

What is the minimum surface of absorbing material on the wall (a = 0.6 at 250 Hz) in order to reduce the equivalent SPL by 3 dB at this frequency (250 Hz), in the reflected field (at distances greater than the reverberation radius) ?

Remarks :

- air absorption can be neglected
- c=340 m/s

Table 1 : Absorption coefficients

Surface	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
Floor	0.20	0.20	0.20	0.20	0.20
Absorbing ceiling	0.20	0.20	0.40	0.70	0.80
Bare walls (concrete blocks)	0.20	0.20	0.30	0.30	0.40