3 Sound level emission of a turbine are given by

Freq. (Hz)	62.5	125	250	500	1000	2000	4000	8000
L_{fT}(dB)	122	116	116	115	97	85	60	57

Determine

a) A-weighted sound level L_{AT}

b) RMS sound pressure for the frequency octave-band centred in 1 kHz

1 Octave-bands are defined from the following band centers: [62.5, 125, 250, 500, 1000, 2000, 4000, 8000] (Hz)

2 Octave-bands limits are established around their centers, for instance: [44.2, 88.4, 176.8, 353.6, 707.1, 1414, 2828, 5657, 11314] (Hz)

3 A band pass filter is applied to the sound pressure signal $p_{os}(t)$ for each octave band. So that, for each band center frequency f a filtered sound pressure for that band is obtained $p_f(t)$

4 Calculation of each octave-band sound level

$$L_{fT} = 10\log_{10}\left(\frac{\frac{1}{T}\int_0^T p_f^2(t)dt}{p_{ref}^2}\right) \text{ dB} \quad (3)$$

5 A-weighting function A_f (dB) for each frequency is given by

Freq. (Hz)	62.5	125	250	500	1000	2000	4000	8000
A_f(dB)	-26.2	-16.1	-8.6	-3.2	0	1.2	1	-1.1

6 A-weighted level of each octave-band is done by aggregating to the each sound level L_{fT} its correspondent A-weighting function value A_f

$$L_{Aft} = L_{fT} + A_f \quad (4)$$

Freq. (Hz)	62.5	125	250	500	1000	2000	4000	8000
L_{fT}(dB)	122	116	116	115	97	85	60	57
A_f(dB)	-26.1	-16.1	-8.6	-3.2	0	1,2	1	-1.1
L_{Af} →	95.8	99.9	107.4	111.8	97	86.2	61	55.9

7 All bands levels are incorporated to determine the A-weighted sound pressure level L_{AT} during the interval T

$$L_{AT} = 10\log_{10}\left(\sum_{j=1}^{8} 10^{0.1\cdot L_{Af_j T}}\right) \quad (5)$$

$$L_{AT} = 10\log_{10}\left(10^{9.58} + 10^{9.99} + 10^{10.74} + 10^{11.18} + \cdots + 10^{6.1}\right)$$

$$= 10\log_{10}(2.53\cdot 10^{11}) = 113.5 \text{ dB}$$

b) $L_{gs} = 97 \text{ dB} = 20\log_{10}\frac{p_{gs_{rms}}}{p_{ref}}$

$$\frac{p_{gs_{rms}}}{p_{ref}} = 10^{\frac{97}{20}}$$

$$p_{gs_{rms}} = 10^{\frac{97}{20}}\, p_{ref} = 10^{\frac{97}{20}}\, 20\cdot 10^{-6} P_a = 1,42 P_a$$