Test Music

Reminder of the formulae.

- Expression of the wavelength λ as a function of the celerity v of the wave and its period T:
$$\lambda = v \cdot T$$
- Celerity of sound in normal conditions of pressure and temperature: $v = 340\ \mathrm{m \cdot s^{-1}}$
- Expression of the intensity of sound I created by a punctual source of power P at a distance r:
$$I(\mathrm{W \cdot m^{-2}}) = \frac{P(\mathrm{W})}{4\pi \cdot r(\mathrm{m})^2}$$
- Expression of the level of intensity of sound L as a function of the intensity of sound I and the reference I_0 ;
$$L(\mathrm{dB}) = 10 \cdot \log\left(\frac{I(\mathrm{W \cdot m^{-2}})}{I_0(\mathrm{W \cdot m^{-2}})}\right)$$
- Equivalent expression of I as a function of L and I_0 : $I = I_0 \cdot 10^{\frac{L}{10}}$ with $I_0 = 10^{-12}\ \mathrm{W \cdot m^{-2}}$

Knowledge (16 points)

1. Give a precise definition of what sound is from the point of view of a physicist. Detail the meaning of each term that you may use.
2. What is called a pure sound? How is it obtained? How is it visualized on the screen of an oscilloscope?
3. What makes the difference between a musical sound and a noise? How do you visualize it on the screen of an oscilloscope?
4. What is the period of a musical sound? Give its value if its frequency is equal to 440 Hz?
5. What is the spectrum of a sound? What is the origin of it and what is it used for?
6. What is the difference between the same note played by two different instruments, such as a violin and a guitar?
7. What is the meaning of the wavelength? What is its value for a sound of frequency 440Hz?
8. Why do we use a logarithmic scale to define the level of intensity of sound? What is the value of the dangerous threshold for the human ear?

Exercise 1 (2 points)

Consider a radio creating a 70dB level of intensity of sound at a given distance. How many of them would create an 82 dB level of intensity of sound if functioning together and you remained at the same distance?

To find out the answer, you will have to prove that doubling the power makes the level of sound increase by 3dB.

Exercise 2 (2 points)

At 1m from the stage, the level of intensity of sound is equal to 90dB. How far should the listener stay so as to make the level of intensity of sound drop to 72 dB?

To find out the answer, you will have to prove that doubling the distance makes the level of sound decrease by 6dB.