Exercise - week 2

1. Calculate the wave propagation speed in the 6th string, the highest (to the right).

2. Calculate the tension in the 6th string.

3. One of the bands, in the beginning of the neck of the guitar, is marked with two white dots. What might they indicate? What frequency do we hear when we play a string and pressing that band, for any string?

4. A sound wave with pressure function

$$p(x,t) = \hat{p}e^{i(\omega t + kx)}$$

incidents on a hard wall at $x = 0$ where we get complete reflection. Plot the amplitude as a function of distance from the wall and give the amplitude at

a) $x = 0$ b) $x = \lambda/2$ c) $x = \lambda/4$ d) $x = \lambda$ e) $x = \lambda/6$

What is the difference in dB between the incident wave and the measured, which is the sum of the incident and reflected wave?

5. Maximum sound absorption and energy loss is achieved in the locations where the air has the largest movements, i.e. where the particle velocity is maximal. Suppose that we place a thin absorbent at the distance $x = 0.35$ m from a hard wall.

a) For which wavelengths can we expect a high sound absorption for normal incident to the wall?

b) For which frequencies can we expect a high sound absorption for normal incident to the wall?

6. A tiled bathroom has the floor area 1.65×2.8 m^2. Calculate the five lowest eigenfrequencies of the room and give the respective eigenmode, if we can suppose that the ceiling is totally absorbing and only consider horizontal oscillations.

7. A sound wave incidents normal from a medium 1 to another medium 2. How much of the sound pressure will be transmitted and reflected if

a) $Z_1 << Z_2$
a) $Z_2 >> Z_1$
b) $Z_1 = Z_2$
c) $Z_1 = 0.5 \cdot Z_2$

What do the first three cases mean? Give a physical interpretation of the situations and the results in a – c.

8. A sound wave incidents normal from air (Z_{luft} = 415 Pa·s/m) towards a water surface (Z_{vatten} = $1.48 \cdot 10^6$ Pa·s/m).
a) How much do the sound level decrease when it continues down in the water?
b) What sound level gets reflected at the surface and continues upwards in the air?
c) How does the ear handle the huge difference in impedance between outer ear (air) and inner ear (fluid)?

Answers

4. a) $2\,\hat{p}$ b) $2\,\hat{p}$ c) 0 d) $2\,\hat{p}$
e) $\hat{p}$

5. a) $\lambda = x/(1/4+n/2)$ = 1.4m, 0.47m, 0.28m, 0.2m... b) f = 243, 729, 1214, 1700 Hz

6. f_{10} = 60.7 Hz, f_{01} = 103 Hz, f_{11} = 120 Hz, f_{20} = 121 Hz, f_{21} = 159 Hz.

7. a) $t = 2, r = 1$ b) $t = 0, r = -1$ c) $t = 1, r = 0$
d) $t = 1.33, r = 0.33$

8. a) -30 dB, b) -0 dB