PhCh summary ch. 7

7.1 Making and hearing sounds

Sound source: an object that makes noise.

Voice: vibrations in vocal cords.

Loudspeaker: the cone vibrates

Guitar: the strings vibrate 🡪 makes the soundbox vibrate

Sound vibrations: pressure differences in the air.

Molecules are forced together 🡪 air pressure increases.

Molecules are spaced out 🡪 air pressure drops.

Molecules are continually colliding with each other.

Their movements get passed on from one to the next. (etc etc)

🡪 pressure changes move away to every direction 🡪 ears.

(you can only hear the sound if there’s a medium to carry it)

Medium: a substance that the vibrations can pass through from the sound source to your ears.

(not only air, but e.g. also through your skull)

Speed of sound: 340 m/s (through air).

To calculate the distance between the sound source and the receiver:

Distance (m) = speed of sound (m/s) x time (s)

S = V x T

V= S : T

T= S : V

Hearing sounds

The eardrum moves inwards when the air pressure in the ear canal increases.

The eardrum moves outwards when the air pressure in the ear canal decreases.

Sound waves reach the ear 🡪 ear drum vibrates along with them.

Ossicles transmit the vibrating movement of the eardrum to the liquid in the cochlea. Cochlea amplifies the sound.

Auditary cells in the cochlea translate the vibrations into electrical signals.

These signals are transmitted along the auditory nerve to the brain.

🡪 you hear the sound.

The speech organ: vocal cords, the cavities in the mouth, throat and nose, tongue and lips.

While speaking: vocal cords contract, lungs force air through the glottis (the small gap between the vocal cords).

🡪 vocal cords vibrate.

Muscles that let you alter the tension of your vocal cords 🡪 let you control the pitch.

Changing the shape of the cavity in your mouth lets you distort the sound of the vocal cords.

Sounds without using your vocal cords: s or p.

(you close the airflow off with your lips, so that a small amount of pressure accumulates behind them. The pressure is released when you relex your lips 🡪 explosion of air)

7.2 Pitch and frequency

String instruments

If a string vibrates 🡪 it produces a tone.

Tone: a sound with a definite pitch.

The pitch of the tone that a string produces depends on 3 factors:

* The thickness of the string: the thicker the string, the lower the pitch.
* The length of the string: the longer the string, the lower the pitch.
* The tension in the string: the lower the tension, the lower the pitch.

To tune an instrument: adjust the string tensions corectly (tuning fork / electronic tuner).

Frequency: amount of vibrations per second. (Hz)

The higher the frequency, the higher the pitch of the tone you hear.

Investigating sound vibrations:

Microphone “translates” the pressure differences of the sound into an electrical signal.

The oscilloscope then shows that signal on the screen. (set of axes)

🡪 lets you investigate how rapidly the air pressure is changing.

Set of axes

Horizontal axis: time

To set the time scale (knobs) = selecting the time base.

1 ms per division means that every square is one millisecond wide.

4 vibrations take up 9 squares.

9 x 1ms = 9ms

9:4= 2.25 ms.

🡪 2.25 is the period.

Period: time required for a single complete vibration.

Frequency (Hz) = 1 : period (seconds)

F = 1 : T

“An octave higher”: the same note, one tone higher.

If you double the frequency, you get the same note again, but one octave higher.

You can hear tones between 20 Hz and 20 000 Hz.

These tones are within the frequency range of your hearing.

Older 🡪 frequency range changes 🡪 less able to hear high-pitched tones.

Ultrasound: sound at frequencies above 20 000 Hz.

You cannot hear these sounds.

(Some animals can hear it. Used for echos)

Infrasound: sounds with frequencies below 20 Hz.

You cannot hear it. (sometimes you can feel it)

7.3 Noise levels

Louder tone: larger amplitude, pressure differences in the surroundings becomes greater.

Amplitude: the maximum displacement with respect to the zero reference in the middle.

The amplitude increases as the sound intensity becomes greater.

No sound: amplitude = 0

Unit of sound intensity: dB.

Decibel meter: device to measure the sound intensity

1000 Hz or 0 Db can’t be heard.

The closer to the sound source the higher the sound level.

Limit of hearing: threshold level at which you are just beginning to be able to detect sound.

Pain treshold: the sound intensity at which your ears start to hurt .

If the number of sound sources becomes twice as great the sound level increases by 3 dB.

Doubling the distance between yourself and a point sound source reduces the sound intensity by 6 dB.

Doubling the distance between yourself and a linear sound source reduces the sound intensity by 3 dB.

7.4 Combating noise nuisance

Noise nuisance: irritating sound.

(can affect your health (stress, lack of sleep, poor concentration)

Noise abatement measures

At the source:

* Low-noise asphalt
* Speed restrictions
* Low-noise engines/tyres

Between the source and the receiver:

* Noise barriers (embankments and screens)
* Commercial premises

At the receiver:

* House insulation
* Ear defenders

Absorbing or reflecting sound

Absorbing sound: (soft and irregular surfaces)

* Shrubs
* Black sound proofing material

Reflecting sound: (hard and smooth surfaces)

* Screen

Sound insulation (either at the source or at the receiver)

* Glass wool
* Earmuffs/earplugs

Audiogram: a graph showing you what your hearing is like, compared to normal hearing.