

MEDICAL PHYSICS

2-3 Frequency response

1. (a) normal hearing 1000 Hz to 5000 Hz

Up to about 3000 Hz the ear becomes more responsive to the sound. After 3000 Hz it becomes less responsive

(b) normal hearing 10 000 Hz upwards

After 10 000 Hz the ear becomes rapidly less responsive to the sound. At about 18 000 Hz the ear does not respond at all.

2. (a) a dBA scale is an adjusted decibel scale which matches the ear's response at different frequencies

(b) Sound of constant intensity 60 dB

(i) At 100 Hz the least detectable intensity is 40 dB.

A 60 dB sound would therefore have an apparent intensity of 20 dB (it is 20 dB above the threshold of hearing)

dBA 20 dB

dB 60 dB

difference 40dB

(ii) At 1000 Hz the least detectable intensity is 0 dB.

A 60 dB sound would therefore have an apparent intensity of 60 dB (it is 60 dB above the threshold of hearing)

dBA 60 dB

dB 60 dB

difference 0 dB

(c) At 10 000 Hz the least detectable intensity is 40 dB.

A 60 dB sound would therefore have an apparent intensity of 20 dB (it is 20 dB above the threshold of hearing)

dBA 20 dB

dB 60 dB

difference 40dB

3. To measure the hearing loss of a person at a particular frequency, a signal generator is set to 1000 Hz and the volume control adjusted until a sound-level meter indicates a particular intensity level in decibels. This is the loudness. The frequency is then changed to the one under investigation and the volume control adjusted until the person thinks it is as loud as the one at 1000 Hz. The sound-level meter is read again. The value obtained can then be compared with that for normal hearing. The increase in the threshold intensity compared to normal hearing is the hearing loss. E.g. if the person has a threshold intensity of 50 dB compared to a normal threshold of 20 dB then they have a 30 dB hearing loss.

4. (a) – Hearing loss at all frequencies due to age
- Hearing loss in a narrow frequency range due to excessive and prolonged exposure to noise in that range e.g. due to machines
- (b) – Both lead to an increase in the threshold of hearing
- Machine induced loss does not increase with frequency.