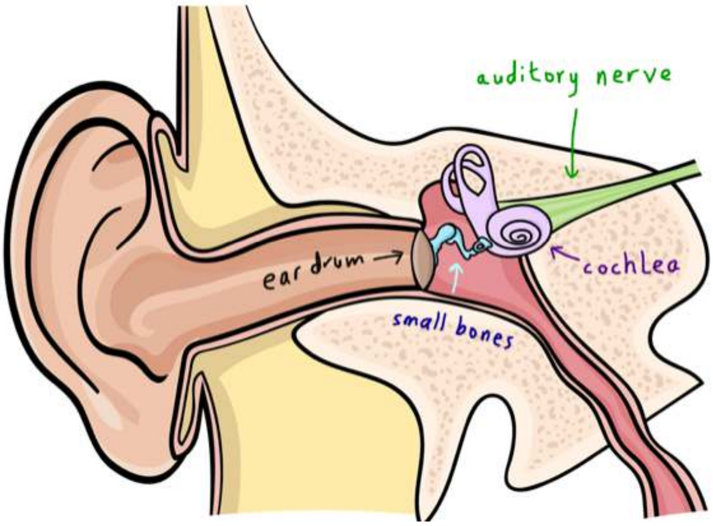
0	1

The main parts of the human ear are shown in the below diagram.



0	1	.	1

Explain how the incidence of a sound wave onto the ear drum causes the brain to perceive (or 'hear') a sound.

A sound wave causes our ear drum to vibrate/oscillate [1]. These vibrations/oscillations are transmitted via small bones (called the hammer, anvil and stirrup) to the cochlea [1]. The cochlea coverts these vibrations into an electrical signal [1] which is sent to the brain via the auditory nerve [1]. Any THREE points.

0	1	.	2

In what way is the operation of the human ear similar to that of a moving coil microphone?

Both 'devices' convert the kinetic energy of a moving sound wave into electrical energy / the ear drum vibrates in response to a sound wave in the same way that the flexible diaphragm of a microphone does [1].

0	1	.	3

What are the minimum and maximum frequencies which a human can hear?

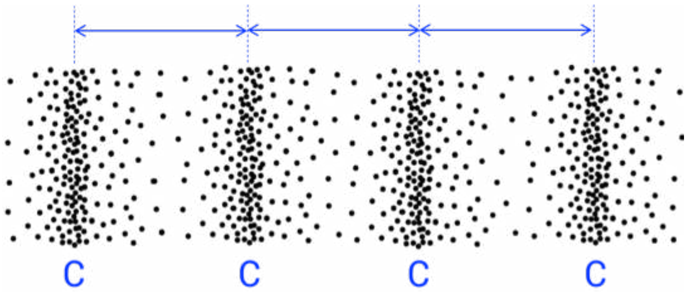
Minimum = 20 Hz Maximum = 20,000 Hz

0	1	.	4

As we get older, both the range and sensitivity of our hearing gets worse. Write down one possible cause of this hearing loss.

The ear drum, small bones within the ear or cochlea naturally become worse at responding to sound waves / short, medium or prolonged exposure to loud sounds / medical conditions / hereditary hearing loss (genetic reasons) [1]. Any ONE.

0 2 The below **full-scale** diagram represents a sound wave as it travels through the air.



0 2 . 1 Mark the positions of each of the **compressions** in the above sound wave with the letter **C**.

0 2 . 2 Use a ruler to determine the **wavelength** of this wave.

Wavelength = **2.3 cm** (accept answers in range 2.0 – 2.6 cm)

0 2 . 3 Hence determine its **frequency**. The speed of sound in air is 340 m/s.

Frequency, $f = v \div \lambda = 340 \div 0.023 = 14{,}800$ Hz = **14.8 kHz** (2 s.f.)
(Accept answers in range 13 – 17 kHz)

Don't forget to convert the wavelength from centimetres to metres here before using $v = f\lambda$.

0 2 . 4 Will this wave be audible to a young person with normal hearing?

Yes ☑

No ☐

0 2 . 5 This wave is then incident onto the surface of a lake, and is partially transmitted into the water. How (if at all) will its frequency and wavelength change as it enters the water? The speed of sound in water is approximately 1500 m/s.

As the wave enters the water, its wavelength will *increase* [1] but its frequency will *stay the same* [1].

Top tip: the frequency of a wave remains constant, regardless of the material it is travelling through or the speed it is travelling at. From the wave equation ($v = f\lambda$), we can see that this means that $v \propto \lambda$, so an increase in wave velocity results in an increase in wavelength.