Q1.

(a)   A stadium is full of spectators. The peak sound-intensity level at the centre of the stadium is 110 dB.

On another occasion the number of spectators in the stadium is reduced by 60%.

Estimate the peak sound-intensity level at the centre of the stadium.

You should assume that on both occasions:

- the sound intensity produced by each spectator is the same
- the spectators are distributed evenly around the stadium.

peak sound-intensity level = _____ dB

(4)

(b)   Describe the changes to a person's hearing that may result from **prolonged** exposure to sound at 110 dB.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q2.

(a)   Define sound intensity.

_____

_____

_____

(1)

(b)   The intensity level, in dB, of a sound is I.

What is the intensity level of a sound with double the intensity?

Tick ✓ **one** box.

$I + 2$ ☐

$I + 3$ ☐

$I + 7$ ☐

$2I$ ☐

$3I$ ☐

I^2 ☐

(1)

(c)   The amplitude of the pressure wave at the oval window of an ear is 20
times greater than at the tympanic membrane.

Calculate the ratio $\dfrac{\text{force on oval window}}{\text{force on tympanic membrane}}$.
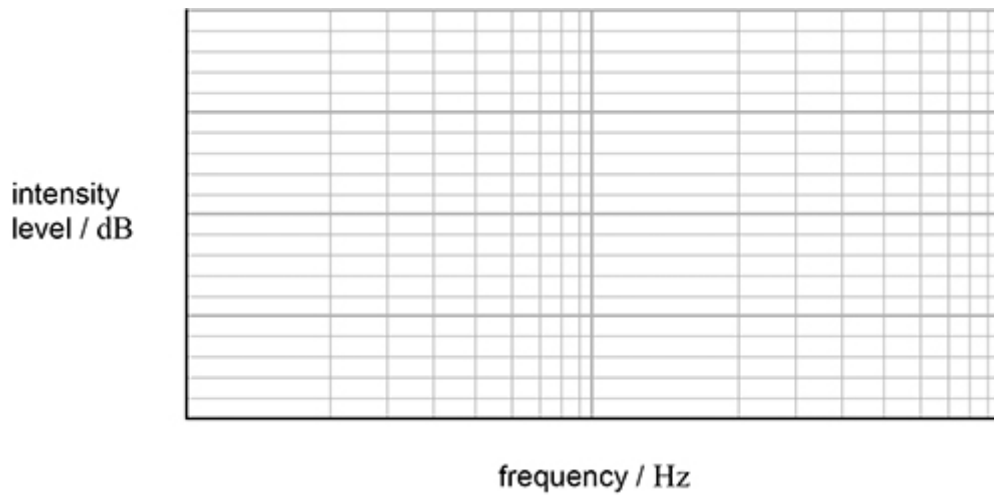
area of oval window = 5.9×10^{-6} m²
area of tympanic membrane = 7.2×10^{-5} m²

ratio = _____

(2)
(Total 4 marks)

Q3.

(a) Sketch an equal loudness curve on the figure below showing the normal response of a healthy ear.
Annotate the **frequency** axis with an appropriate scale.

intensity level / dB

frequency / Hz

(3)

(b) Describe the procedure used to gather the data for an equal loudness curve.

_____

_____

_____

_____

_____

_____

(2)

(c) Calculate the intensity of a sound that produces an intensity level of 30 dB.

intensity = _____ W m^{-2}

(2)

(Total 7 marks)