

M503 – Answers to Overnight Questions Day 1

Question 1:

What is the wavelength for sounds with the following frequencies?

100 Hz, 500 Hz, 2,000Hz

Using the formula Wavelength (λ) = c/f

For 2,000 Hertz we have:

Wavelength = $344/2000 = 0.172 \text{ m} = 172\text{mm}$

Table 2.1 - Wavelength in air at standard atmospheric conditions

Frequency	Wavelength
100 Hz	3.44 m
500 Hz	0.68 m
2000 Hz	0.17 m
100,000 Hz	3.4mm

Question 2:

Why is the A weighting often used when measuring sound levels?

The A weighting is a frequency filter that has a similar response as the frequency response of the human ear. It therefore provides a good indication of the subjective reaction to sound and of the potential for hearing damage.

Question 3:

How does the noise level vary with distance from a point source over a non reflecting surface?

The reduction is on the basis of the Inverse – square law. This is a 6 dB reduction in sound pressure level for each doubling of distance from the source.

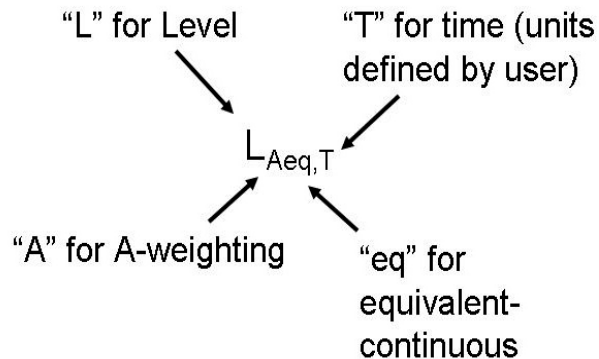
Question 4:

When is the sound power level of a source quoted in preference to the sound pressure level?

When describing the characteristics of the source as sound Power is independent of the environment. With the data on sound power and the acoustic environment it is possible to estimate the noise level at various distances from the source.

Question 5:

Which descriptor is commonly used for assessment of occupational noise?
Explain what each of the component symbols of this descriptor mean.

**Question 6:**

The sound level of one machine is 90 dBA. A second, identical machine is added next to it. The resulting sound level when both machines are running is:

- ☐ 180 dBA
- ☐ 135 dBA
- ☐ 96 dBA
- ☒ 93 dBA
- ☐ 90 dBA

Question 7:

What is the typical frequency range for human hearing?

Human hearing ranges in frequency from approximately 20 Hz to 20,000 Hz.

Hearing is most sensitive to the frequencies present in human speech, approximately 400 Hz – 5000 Hz.

Question 8:

The noise level in the machine area is 83 dBA. The noise level from a new machine at the operator location is quoted as 82 dBA. Will this installation require any changes in the work area?

83 dB plus 82 dB difference is 1 so from the table for addition of dB add 2.5 dB to the higher of the two levels ie $83 + 2.5 = 85.5$ dB.

Yes, needs reassessment of risk as the level is now over 85 dBA.

Question 9:

The noise level at the worker location when a number of machines are operating has been measured as 91 dBA. The noise level from just one of these machines is known to be 89 dBA and management have suggested that this machine could be placed in a separate area and well away from the worker. If this is done what would be the noise level at the worker from the operation of the remaining machines?

The total noise level is 91 dBA. One sound source is known to be 89dBA. Let the sum of the remaining sound sources be X dB.

If X is 89 dBA then $89+89$ would give a total of 92dBA which is too high

If X is 88 dBA then $89+88$ difference is 1 so add 2.5 giving $89+2.5=91.5$ dBA

If X is 87 dBA then $89+87$ difference is 2 so add 2.1 giving $89+2.1=91.1$ dBA which would be rounded to 91 dBA

If X is 86 dBA then $89+86$ difference is 3 so add 1.8 giving $89+1.8=90.8$ dBA which would be rounded to 91 dBA

If X is 85 dBA then $89+85$ difference is 4 so add 1.5 giving $89+1.5=90.5$ dBA which would be rounded to 91 dBA

If X is 84 dBA then $89+84$ difference is 5 so add 1.2 giving $89+1.2=90.2$ dBA which would be rounded to 90 dBA

So if the noise source of 89 dBA is removed the remaining noise level at the worker could be between 86 and 84dBA. So a noise management plan would still be needed.

Question 10:

Explain concisely how sound is transmitted through the components of the ear.

Sound is funnelled to the eardrum by pinna and ear canal.

Eardrum vibrates and mechanical vibrations transmitted via ossicles to oval window of cochlea.

Energy is propagated through fluid and excites basilar membrane which triggers hair cells and energy is then converted to electrical energy and transmitted via the auditory cortex to the brain.