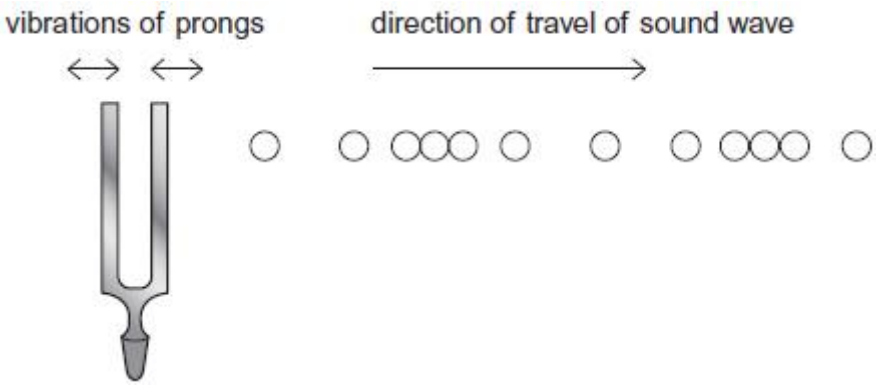
Name of the Student:_____
Max. Marks : 16 Marks **Time : 16 Minutes**

Q1.

Musicians can use tuning forks to tune their instruments.
A tuning fork produces a specific frequency when it vibrates.

Figure 1 shows a tuning fork vibrating in air at a single instant in time.
The circles represent the positions of air particles in the sound wave.

Figure 1



(a) The tuning fork emits a wave that has a frequency of 0.51 kHz.

(i) State the meaning of the term frequency of a wave.

_____

(1)

(ii) Air particles vibrate in different phases in the direction in which the wave is travelling.

Calculate the minimum separation of particles that vibrate 180° out of phase.

speed of sound in air = 340 m s^{-1}

minimum separation _____ m

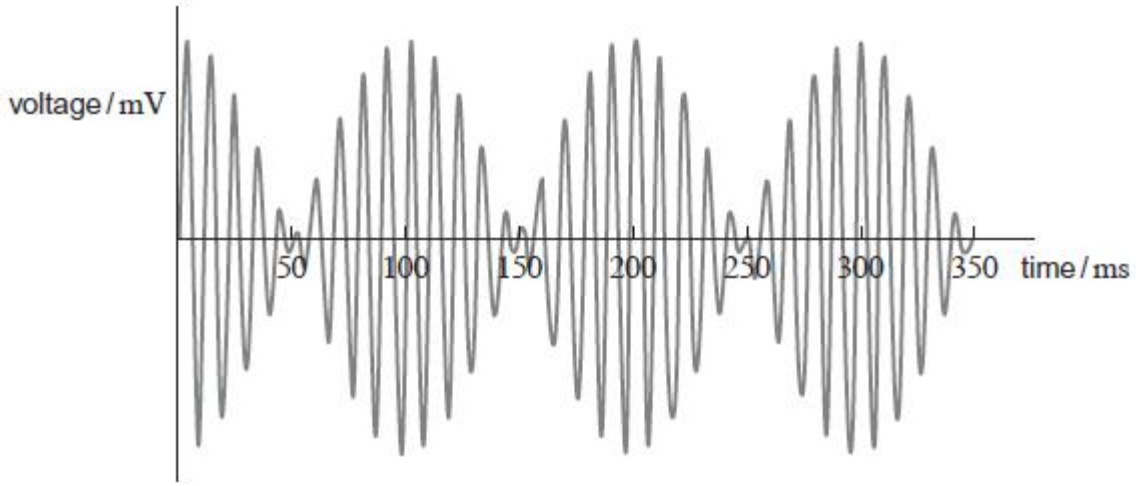
(3)

(b) A student sets a tuning fork of lower frequency vibrating at the same time as the 0.51 kHz tuning fork in part (a).

The student detects the resultant sound wave with a microphone. The variation with time of the

voltage generated by the microphone is shown in **Figure 2**.

Figure 2



(i) Explain why the two tuning forks are **not** coherent sources of sound waves.

_____

_____

_____

_____

(2)

(ii) Explain why the resultant sound has a minimum amplitude at 50 ms.

_____

_____

_____

_____

_____

(3)

(iii) Calculate the frequency of the tuning fork that emits the lower frequency.

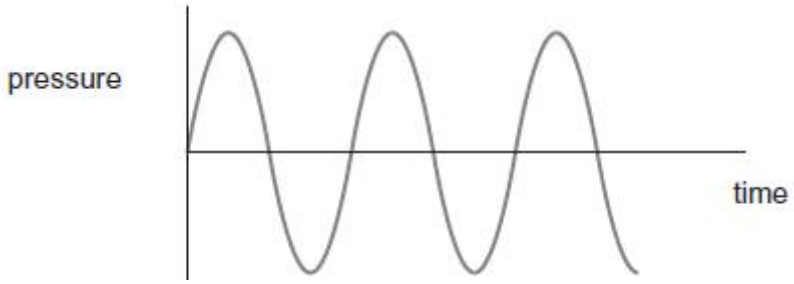
frequency _____ Hz

(3)

(c) A signal generator connected to a loudspeaker produces a sinusoidal sound wave with a frequency of 440 Hz.

The variation in air pressure with time for this sound is shown in **Figure 3**.

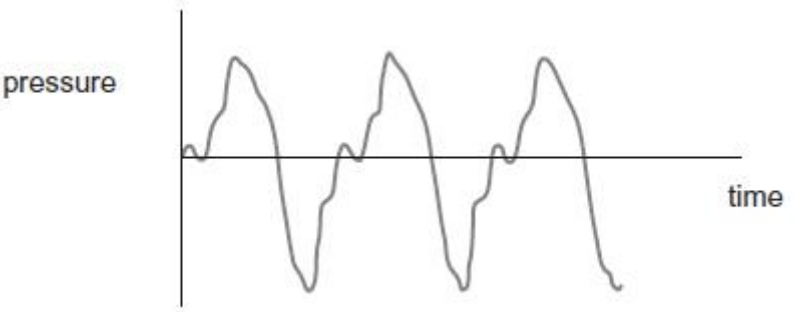
Figure 3



A violin string has a fundamental frequency (first harmonic) of 440 Hz.

Figure 4 shows the variation in air pressure with time for the sound created by the violin string.

Figure 4



(i) The two sounds have the same pitch but sound different.

What term describes the difference between the sounds heard?
Tick (✔) the correct answer.

Frequency modulation	☐
Octaves	☐
Path difference	☐
Quality	☐

(1)

(ii) The complex sound in **Figure 4** can be electronically synthesised.

Describe the process of electronically synthesising this sound.

(3)
(Total 16 marks)