5 **(a)** A loudspeaker oscillates with frequency f to produce sound waves of wavelength λ. The loudspeaker makes N oscillations in time t.

(i) State expressions, in terms of some or all of the symbols f, λ and N, for:

1. the distance moved by a wavefront in time t

distance = ...

2. time t.

time t = ...
[2]

(ii) Use your answers in **(i)** to deduce the equation relating the speed v of the sound wave to f and λ.

[1]

(b) The waveform of a sound wave is displayed on the screen of a cathode-ray oscilloscope (c.r.o.), as shown in Fig. 5.1.

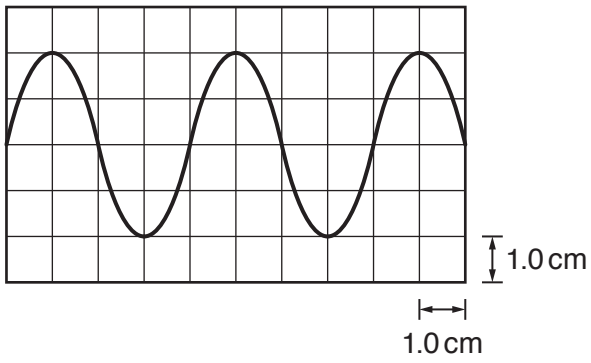

Fig. 5.1

The time-base setting is 0.20 ms cm^{-1}.

Determine the frequency of the sound wave.

frequency = ... Hz [2]

(c) Two sources S_1 and S_2 of sound waves are positioned as shown in Fig. 5.2.

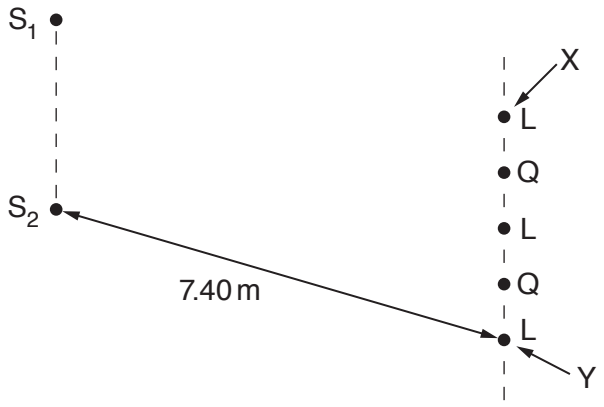

Fig. 5.2 (not to scale)

The sources emit coherent sound waves of wavelength 0.85 m. A sound detector is moved parallel to the line S_1S_2 from a point X to a point Y. Alternate positions of maximum loudness L and minimum loudness Q are detected, as illustrated in Fig. 5.2.

Distance S_1X is equal to distance S_2X. Distance S_2Y is 7.40 m.

(i) Explain what is meant by *coherent* waves.

.....

.....[1]

(ii) State the phase difference between the two waves arriving at the position of minimum loudness Q that is closest to point X.

phase difference = ... ° [1]

(iii) Determine the distance S_1Y.

distance = ... m [2]

[Total: 9]