7 **(a)** A source of sound has frequency *f*. Sound of wavelength λ is produced by the source.

(i) State

1. what is meant by the frequency of the source,

……

…… [1]

2. the distance moved, in terms of λ, by a wavefront during *n* oscillations of the source.

distance = …….. [1]

(ii) Use your answers in **(i)** to deduce an expression for the speed *v* of the wave in terms of *f* and λ.

[2]

(b) An arrangement that can be used to determine the speed of sound in air is shown in Fig. 7.1.

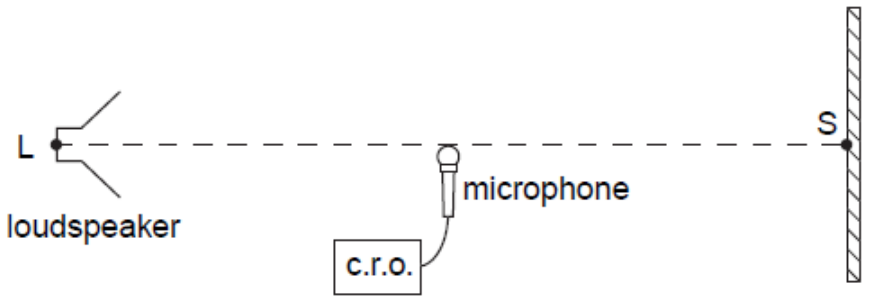

Fig. 7.1

A loudspeaker L is positioned to face a hard surface. Sound waves of constant frequency are emitted from the loudspeaker L. The loudspeaker is then moved away from a point S on the hard surface until a stationary wave is produced.

The variation with distance x of the intensity I of a stationary sound wave is shown in Fig. 7.2.

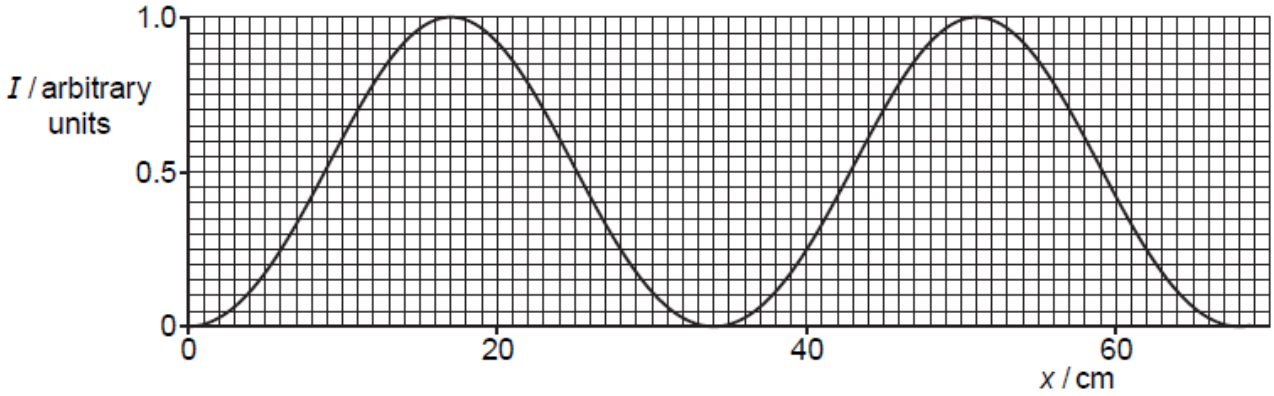

Fig. 7.2

(i) Explain how sound waves from L give rise to a stationary wave between L and S.

……

……

……

…… [2]

(ii) On the x–axis of Fig 7.2, indicate the positions of all nodes and antinodes of the stationary wave. Label the nodes **N** and the antinodes **A**. [1]

(iii) The speed of sound in air is 330 m s^{-1}.

Use Fig. 7.2 to determine the frequency of the sound wave.

frequency = …….. Hz [2]

(iv) Determine the ratio of

$$\frac{\text{the amplitude of the wave when } x = 20 \text{ cm}}{\text{the amplitude of the wave when } x = 40 \text{ cm}}.$$

ratio = …….. [3]

(c) White light is incident on a diffraction grating, as shown in Fig. 7.3.

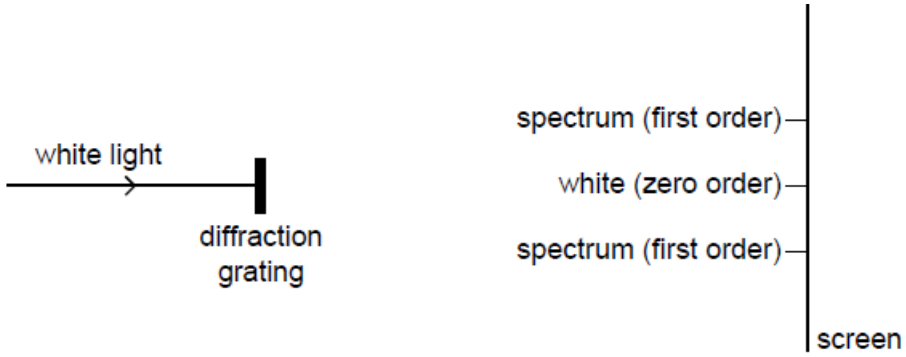

Fig. 7.3 (not to scale)

The diffraction pattern formed on the screen has white, called zero order and coloured spectra in other orders.

(i) Explain

1. the white light at the zero order,

……

……

……

…… [2]

2. the relative difference in position of red and blue light in the first-order spectrum.

……

……

……

…… [2]

(ii) Light of wavelength 625 nm produces a second-order maximum at an angle of 61.0° to the incident direction.

Determine the number of lines per metre of the diffraction grating.

number of lines = …….. m^{-1} [2]

(iii) Calculate the wavelength of another part of the visible spectrum that gives a maximum for a different order at the same angle as in **(ii)**.

wavelength = …….. nm [2]

[Total: 20]