4 An arrangement for producing stationary waves in air in a tube that is closed at one end is shown in Fig. 4.1

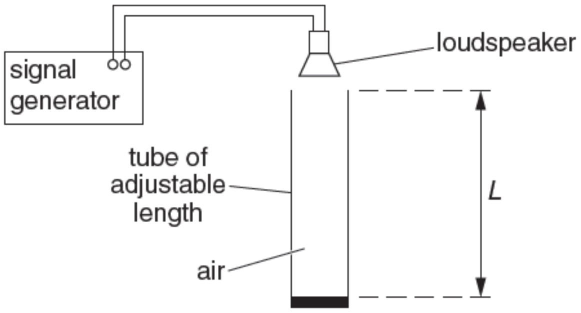


Fig. 4.1

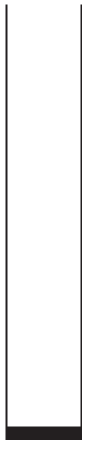
A loudspeaker produces sound waves of wavelength 0.680 m in the tube. For some values of the length *L* of the tube, stationary waves are formed.

(a) The length *L* is adjusted between 0.200 m and 1.00 m.

(i) Determine the two values of *L* for which stationary waves are formed.

L = …………………… m and …………………… m [2]

(ii) On Fig. 4.2, label the positions of all the antinodes with an **A** and the nodes with an **N** for the smallest value of *L* for which a stationary wave is formed.



[1]

Fig. 4.2

(b) A light wave from a laser has a wavelength of 460 nm in a vacuum. The light is incident normally on a diffraction grating.

Describe the diffraction of the light waves at the grating.

…………………………………………………………………………………………………..……………...

…………………………………………………………………………………………………..……………...

…………………………………………………………………………………………………..…………….. [2]

(c) A diffraction grating is used with different wavelengths of visible light. The angle θ of the **fourth**-order maximum from the zero-order (central) maximum is measured for each wavelength. The variation with wavelength λ of $\sin\theta$ is shown in Fig. 4.3.

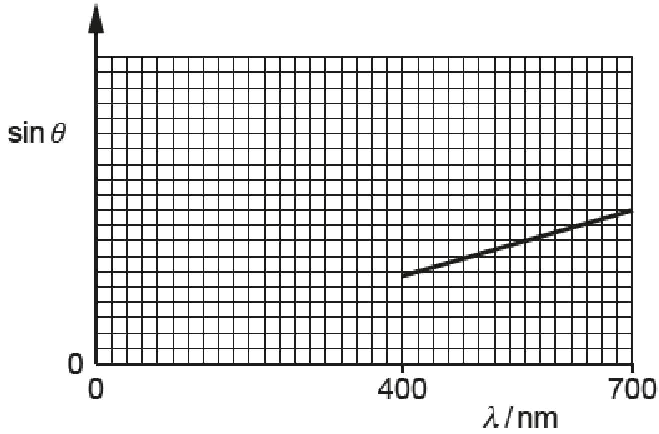


Fig. 4.3

(i) The gradient of the graph is G.
Determine an expression, in terms of G, for the distance d between the centres of two adjacent slits in the diffraction grating.

d = …………………… m [2]

(ii) On Fig. 4.3, sketch a graph to show the results that would be obtained for the **second**-order maxima. [2]

[Total: 9]