7 A helium-neon laser produces light of wavelength 633nm. The laser is placed behind a glass microscope slide that has been painted black. A single vertical slit of width 0.0800mm has been produced by scratching through the paint with a razor blade.

Light from the laser passes through the slit and hits a white wall at a distance of 5.12m from the slit. A patch of red light is formed on the screen. On both sides of this central patch there are smaller, less intense patches.

A light sensor connected to a data logger is moved across the screen and the distance moved by the light sensor and the intensity of the light is recorded. Fig. 7.1 is the intensity-distance graph generated.

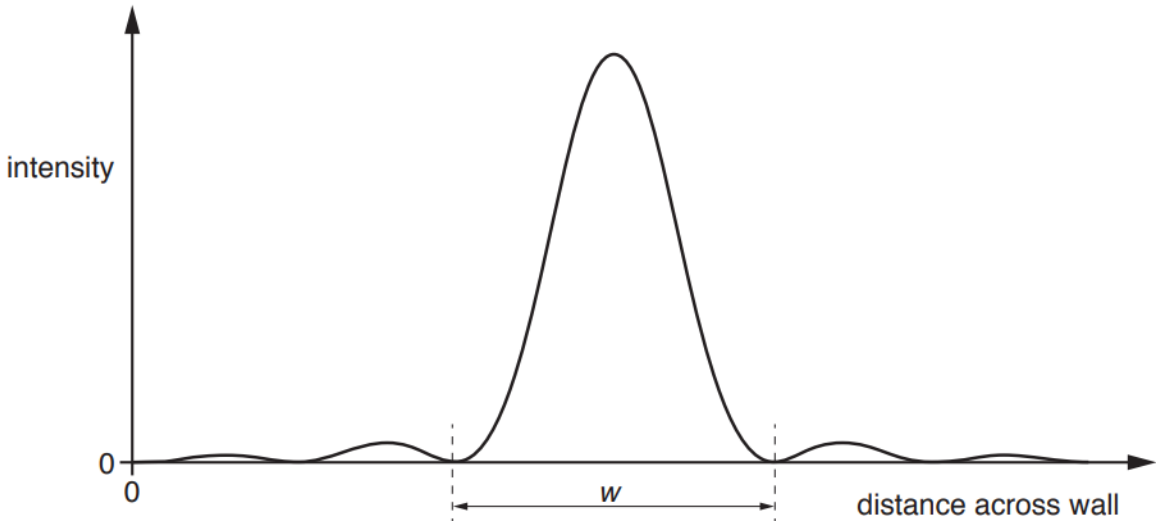

Fig. 7.1

The width *w* of the central patch is equal to the distance between the two minimum points on either side of the central patch where the intensity of red light is equal to zero.

(a) Show that *w* is 0.0810 m wide.

[2]

(b) A second vertical slit of width 0.0800mm is scratched across the slide. The second slit is parallel to the first and its centre is a horizontal distance of 0.240mm away from the centre of the first slit.

The microscope slide now acts as a double slit. At the centre of the double-slit interference pattern on the wall, there are bright and dark fringes which are uniformly spaced.

(i) Some parts of the screen that were brightly lit when only the first slit was present are now dark, even though light is still passing through the first slit in the same way.

Explain what causes this to happen.

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……

…… [1]

(ii) Determine the separation *x* of the bright fringes.

x = …… m [1]

(iii) Most of the bright fringes are separated from adjacent bright fringes by a distance x. In a few places, away from the centre, however, there is no light in a position where a bright fringe is expected.

Using the results from **(a)** and **(b)(ii)**, explain why there is no light at such places.

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…… [2]