5 **(a)** A microphone and cathode-ray oscilloscope (CRO) are used to analyse a sound wave of frequency 5000 Hz. The trace that is displayed on the screen of the CRO is shown in Fig. 5.1.

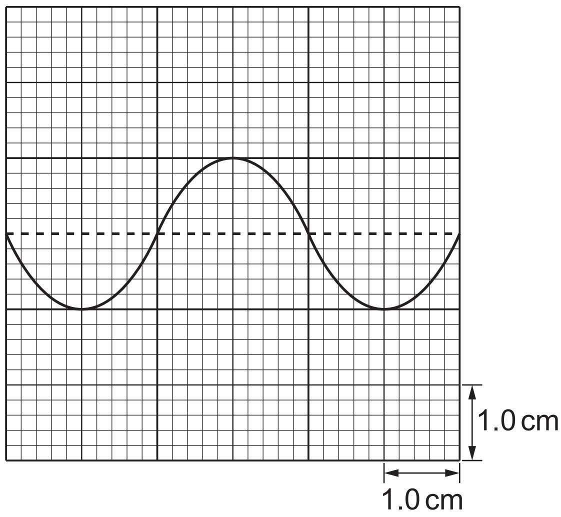

Fig. 5.1

(i) Determine the time-base setting, in $s\,cm^{-1}$, of the CRO.

time-base setting = ... $s\,cm^{-1}$ [2]

(ii) The intensity of the sound detected by the microphone is now increased from its initial value of I to a new value of $3I$. The frequency of the sound is unchanged. Assume that the amplitude of the trace on the CRO screen is proportional to the amplitude of the sound wave.

On Fig. 5.1, sketch the new trace shown on the screen of the CRO. [3]

(b) An arrangement for demonstrating interference using light is shown in Fig. 5.2.

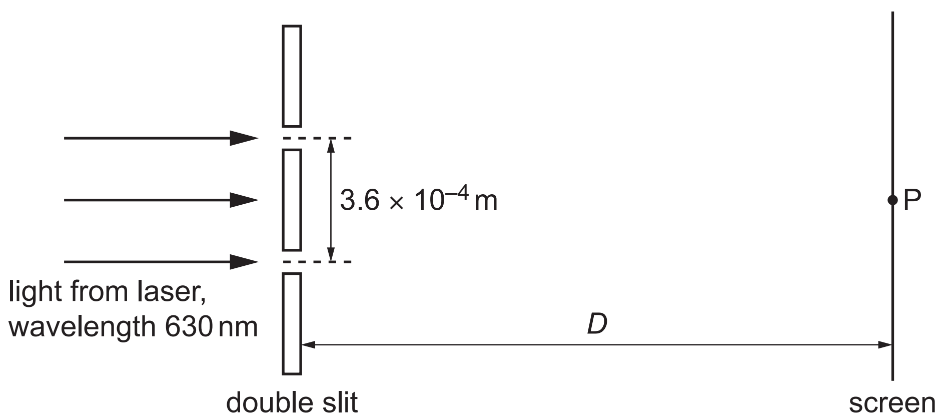

Fig. 5.2 (not to scale)

The wavelength of the light from the laser is 630 nm. The light is incident normally on the double slit. The separation of the two slits is 3.6×10^{-4} m. The perpendicular distance between the double slit and the screen is D.

Coherent light waves from the slits form an interference pattern of bright and dark fringes on the screen. The distance between the centres of two adjacent bright fringes is 4.0×10^{-3} m. The central bright fringe is formed at point P.

(i) Explain why a bright fringe is produced by the waves meeting at point P.

....

.... [1]

(ii) Calculate distance D.

D = ... m [3]

(c) The wavelength λ of the light in **(b)** is now varied. This causes a variation in the distance x between the centres of two adjacent bright fringes on the screen. The distance D and the separation of the two slits are unchanged.

On Fig. 5.3, sketch a graph to show the variation of x with λ from λ = 400 nm to λ = 700 nm. Numerical values of x are not required.

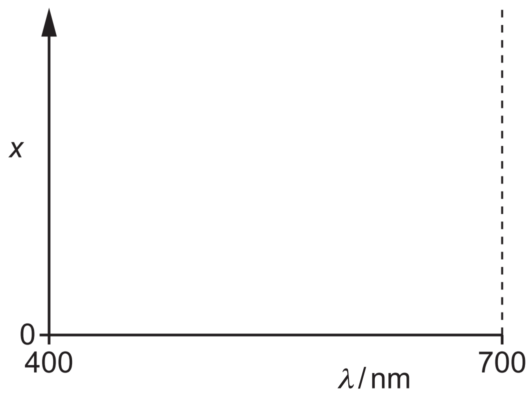

Fig. 5.3

[1]

[Total: 10]