8 The variation with time t of the displacement y of a wave A, as it passes a point P, is shown in Fig. 8.1.
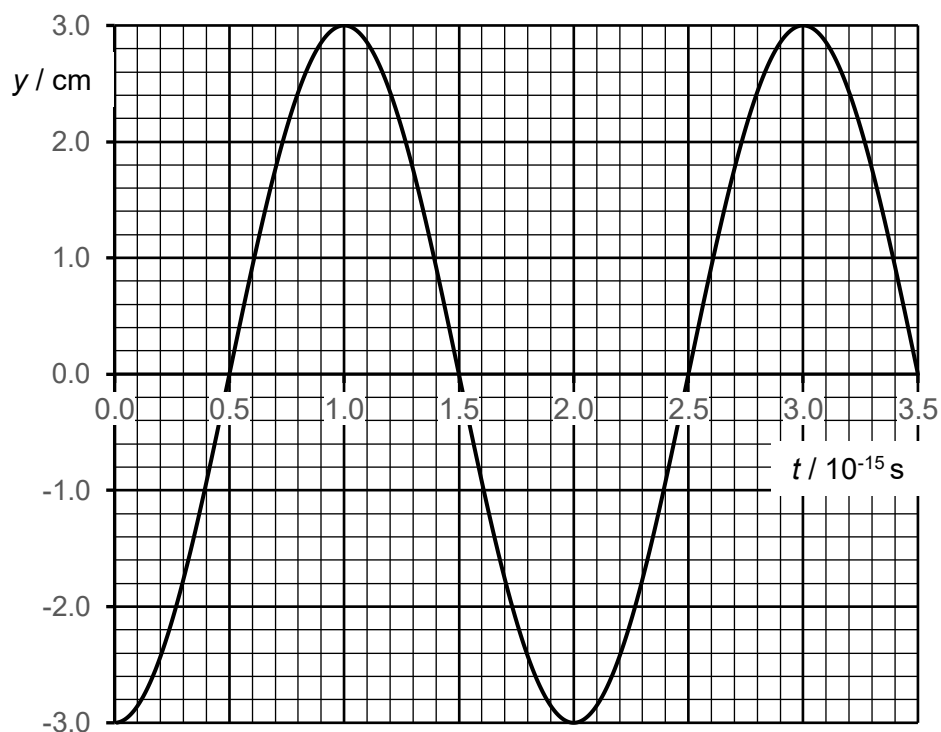

Fig. 8.1

The intensity of wave A is $2I$.

(a) Use Fig. 8.1 to determine the frequency of wave A.

frequency = ... Hz [2]

(b) A second wave B with the same frequency and speed as wave A also passes point P. Wave B has intensity I and is lagging wave A by $\dfrac{\pi}{2}$ rad.

On Fig. 8.1, sketch the variation with time t of the displacement y of wave B. Label the graph B.

Show your working.

[3]

(c) Explain why wave A and wave B are coherent.

....
.... [1]

(d) Wave R is the resultant wave due to the superposition of wave A and wave B. The amplitude of wave R occurs at $t = 1.2 \times 10^{-15}$ s.

Using your answer in **(b)** and Fig. 8.1, determine, in terms of I, the intensity of wave R at point P.

intensity = ... [2]

(e) After passing through point P, wave R is plane-polarised by passing it through a polarising filter. Determine, in terms of I, the intensity of the plane-polarised wave R.
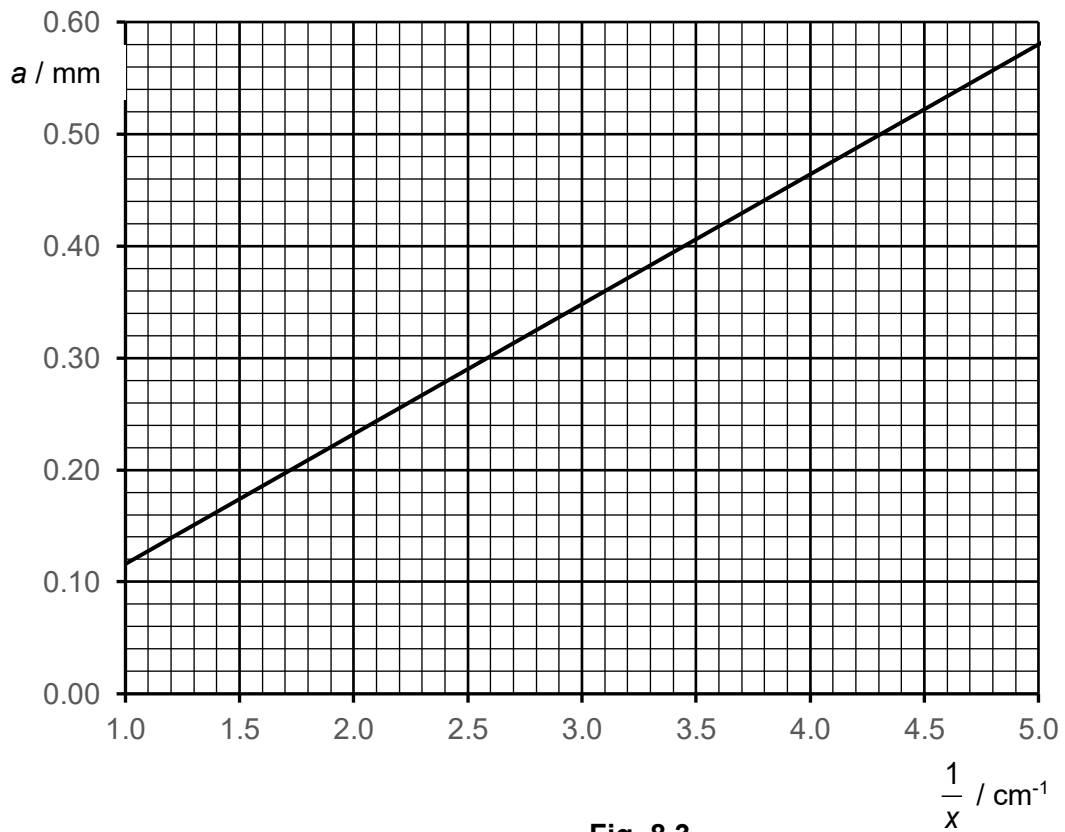
intensity = ... [1]

(f) Wave R is made to pass through a double slit in an interference experiment, as shown in Fig. 8.2.

wave R

double slit   2.00 m   screen
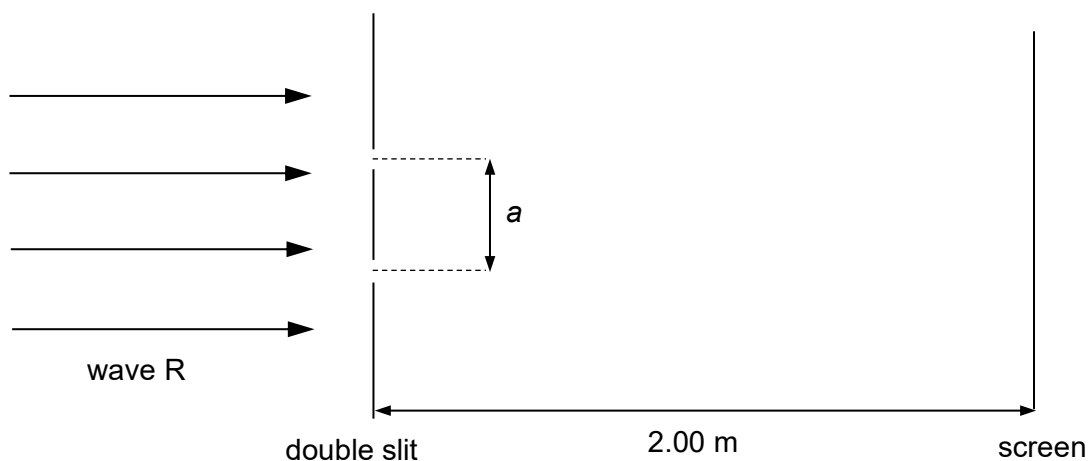
Fig. 8.2

The separation between the slits is *a*. The fringes are viewed on a screen at a distance 2.00 m from the double slit. The fringe separation *x* is measured for different slit separation *a*.

A graph of *a* against $\frac{1}{x}$ is shown in Fig. 8.3.

Fig. 8.3

(i) Determine the wavelength of wave R.

wavelength = ... m [3]

(ii) State the effect, if any, on the appearance of the fringes observed on the screen when the following changes are made separately, at a fixed value of a:

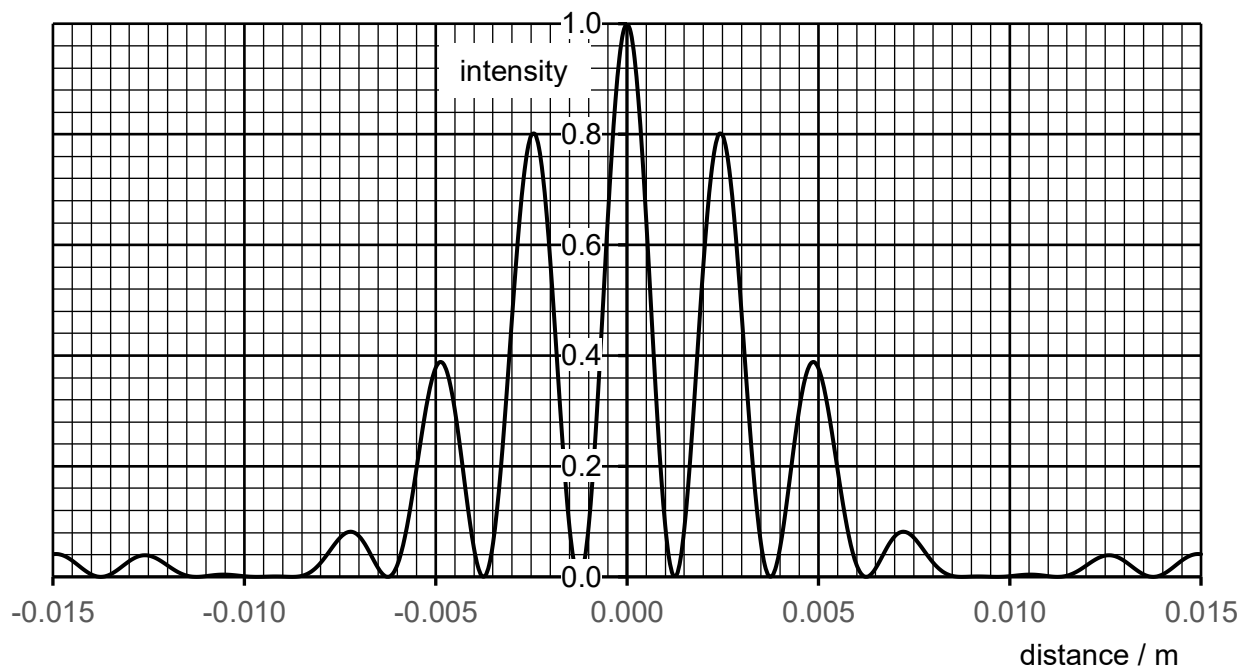**1.** wave R is replaced by a blue laser light,

....

....

.... [1]

2. the width of each slit is increased but the separation remains constant.

....

....

.... [2]

(iii) At a particular value of slit separation a, the variation with distance along the screen of the intensity of the image on the screen is shown in Fig. 8.4.

Fig. 8.4

1. Using Fig. 8.4 and Fig. 8.3, determine the value of a.

a = ... mm [2]

2. Using Fig. 8.4, determine the width of each slit.

slit width = ... m [3]

[Total: 20]