6 **(a)** A ripple tank is used to show the diffraction and interference of waves. On Fig. 6.1, plane wavefronts are shown approaching an object.

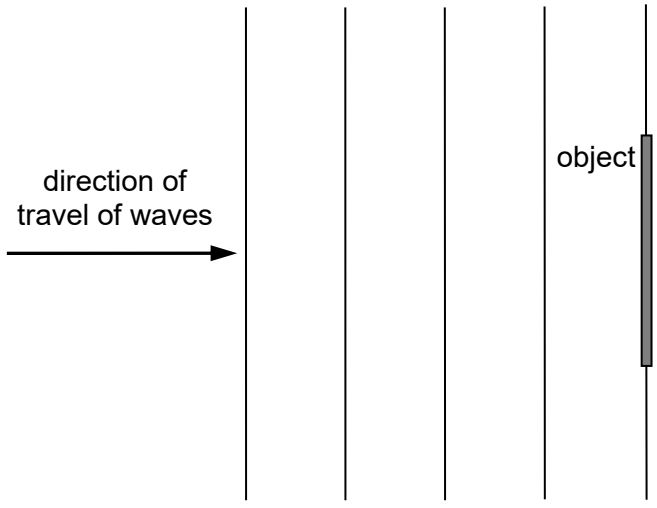

Fig. 6.1

(i) On Fig. 6.1, draw four wavefronts to show the waves after they have passed through the object. [2]

(ii) The object is now made shorter.

Describe the change in appearance of the diffracted wavefronts.

.....

.....[1]

(b) A laser is placed in front of a slit as shown in Fig. 6.2.

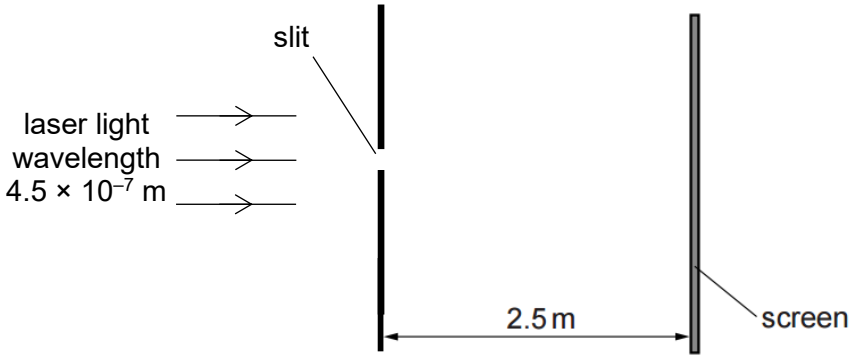

Fig. 6.2 (not drawn to scale)

The laser emits light of wavelength 4.5×10^{-7} m. The distance from the slit to the screen is 2.5 m. The width of the slit is 0.50 mm.

An interference pattern is observed on the screen.

The width of the central fringe as observed on the screen is *y*.

(i) Show that *y* is 4.5 mm.

[2]

(ii) The single slit is replaced with a double slit as shown in Fig. 6.3.

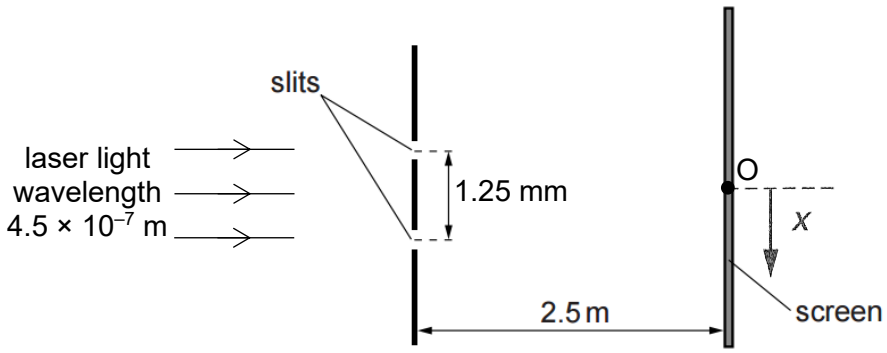

Fig. 6.3 (not drawn to scale)

The separation of the slits is 1.25 mm. The width of each slit is 0.50 mm.

The centre of the interference pattern formed on the screen is at O.

1. Explain why an interference pattern is formed on the screen.

.....

.....

.....

.....

.....

.....[3]

2. Show that there are five bright fringes in the region $-\frac{y}{2} \leq x \leq \frac{y}{2}$, where x is the distance measured downwards along the screen from point O.

[2]

3. On Fig. 6.4, sketch the variation with distance x from point O of the intensity I of the interference pattern formed on the screen.

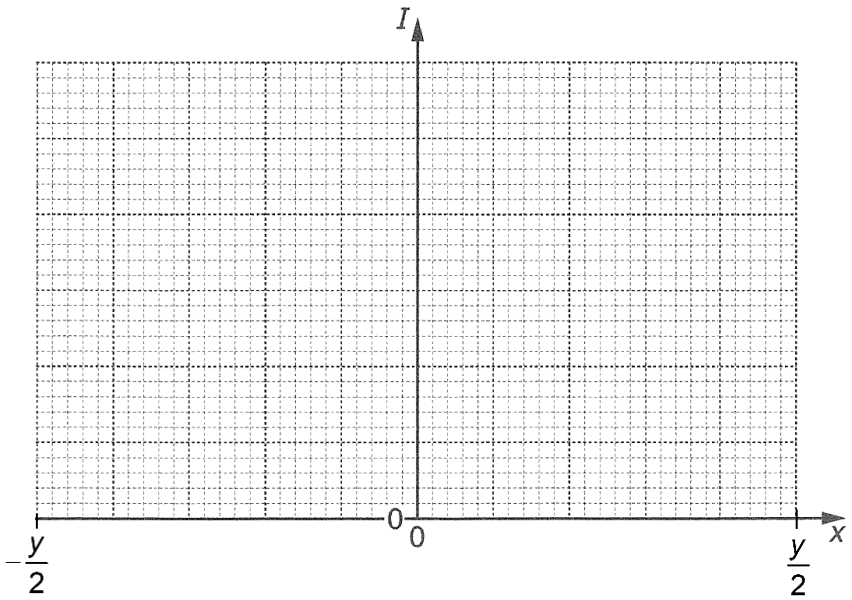

Fig. 6.4

[3]

[Total: 13]