8 **(a)** Explain what is meant by *diffraction* of wave.

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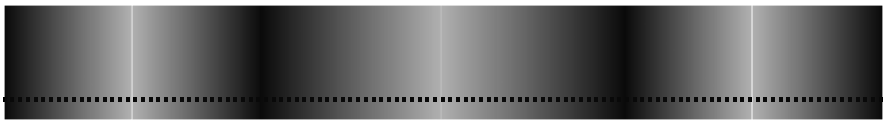

.....

[1]

(b) A laser light of wavelength 633 nm is incident on a single slit of width *b*. A diffraction pattern is formed on a vertical screen 4.2 m away from the single slit.

A photograph of the single slit diffraction pattern is shown in Fig. 8.1.

Fig. 8.1 (drawn to scale)

(i) Determine *b*.

b = ... m [3]

(ii) With reference to the concept of interference, suggest why the value of *b* cannot be less than the wavelength of the laser light.

.....

.....

.....

[2]

(c) A second identical single slit is then placed beside the first slit at a horizontal distance of 0.320 mm away from the centre of the first slit. An interference pattern is then observed.

(i) Explain why an interference pattern is observed on the screen.

.....

.....

.....

.....

[2]

(ii) Calculate the fringe separation of the interference pattern.

fringe separation = ... m [2]

(iii) 1. State the changes to the fringe pattern when the width of both slits is reduced slightly, resulting in the intensity of the light coming out from both slits to be reduced.

.....

.....

.....

.....

[3]

2. Suggest why the intensity of the light coming out from each slit will be reduced when the width of each slit is reduced.

.....

.....

[1]

(d) A thin wedge of air is made by separating two thin glass plates by a spacer as shown in Fig. 8.2.

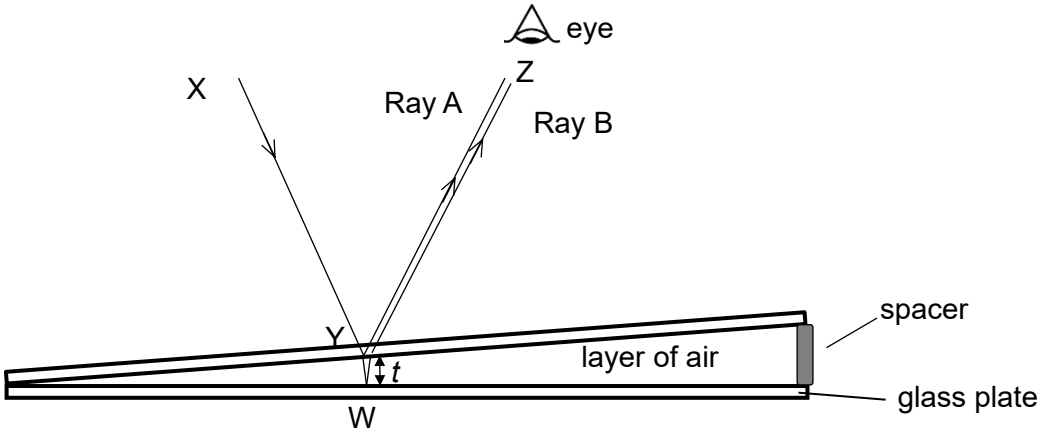

Fig. 8.2

There are two rays of light, Ray A and B, which are directly at the glass plates.

Ray A take the path X→Y→Z.

Ray B take the path X→Y→W→Z.

(i) State the path difference between Rays A and B in terms of *t* which is the thickness of the layer of air between the two glass plates.

path difference = ... [1]

(ii) When the observer moves his eyes across the layer of air, he observes dark and bright fringes that are uniformly spaced. The initial and final position of his eye is shown in Fig. 8.3. At the final position, he is looking at the fifth order dark fringe.

Given that the wavelength of the light directed at the glass plates is 550 nm, determine the thickness of air *t'* at this position.

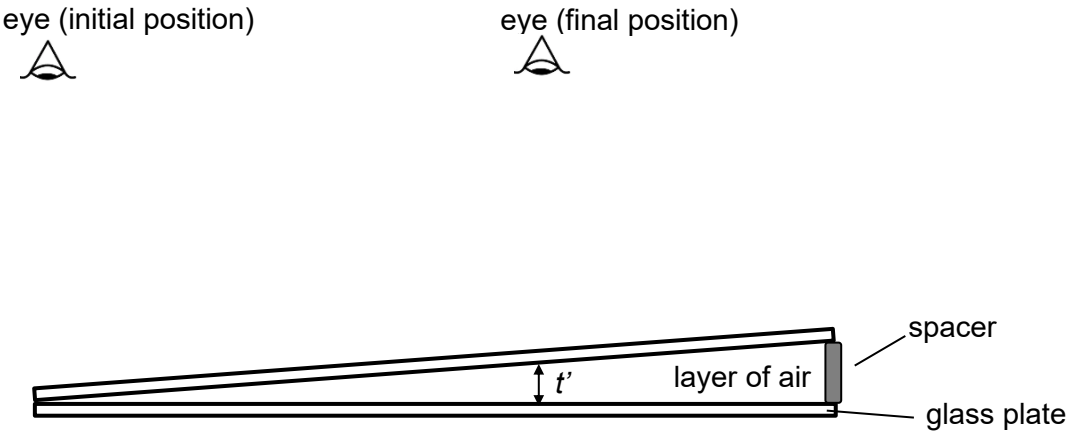

Fig. 8.3

thickness *t'* = ... [2]

(iii) White light of wavelength ranging from 400 nm to 700 nm is now incident on the thin wedge of air. At a certain thickness, a violet colour is observed where violet colour is due to overlapping of red and blue colours.

Explain this observation.

.....

.....

.....

[2]

(iv) In reality, Ray B will undergo a phase change of 180° when it is reflected but there is no phase change for Ray A.

Suggest why the thickness of air cannot be smaller than one quarter of the wavelength in order to observe a bright fringe.

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.....

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[1]

[Total: 20]