Section B

Answer **one** question from this Section in the spaces provided.

8 (a) (i) Explain what is meant by polarisation.

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…….. [1]

(ii) A beam of initially unpolarised light of intensity I_0 is passed through three polaroids. The intensities of the beam emerging from each polaroid are I_1, I_2 and I_3 respectively. The polarising axis of each polaroid is shown by an arrow and held at different angles to the vertical axis, as illustrated in Fig. 8.1.

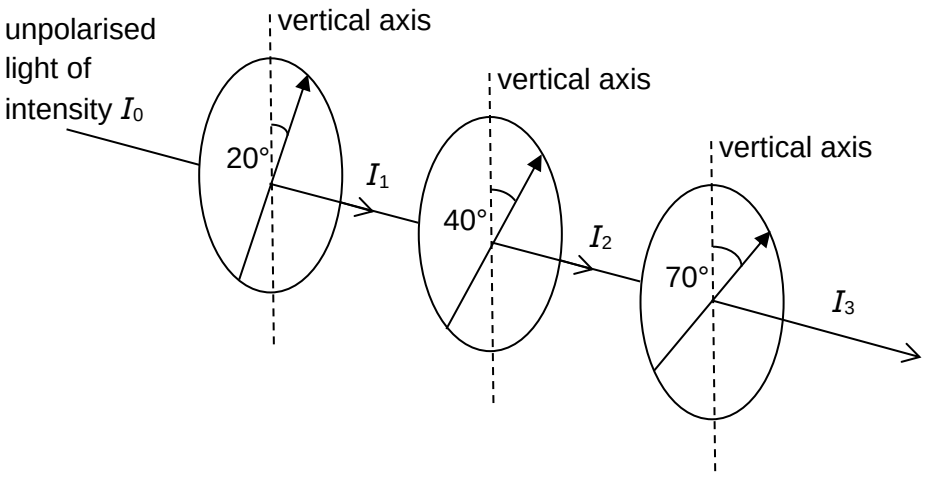

Fig. 8.1

1. State in terms of I_1, the intensity I_0 of the unpolarised light.

intensity I_0 = …… [1]

2. Determine, in terms of I_1, the intensity I_3 of the beam emerging from the third polaroid.

intensity I_3 = …… [2]

(b) The polarised light has a wavelength λ of 650 nm. It is incident normally on a double slit such that the waves emerge from the slits are in phase, and reach a screen 1.5 m away, as shown in Fig. 8.2.

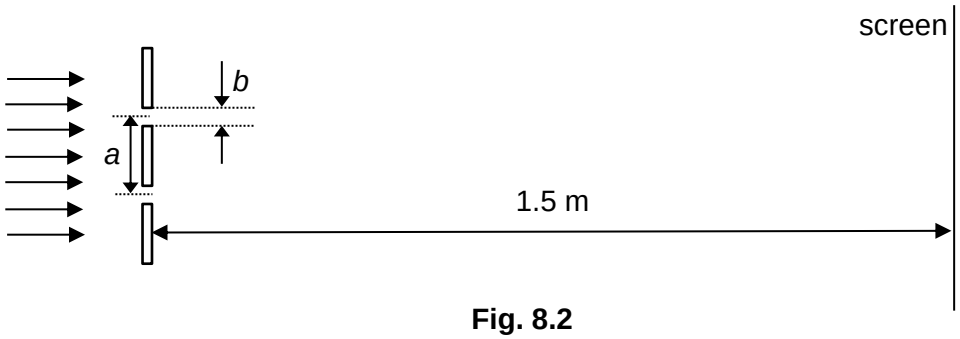

Fig. 8.2

The variation of intensity with distance along the screen is shown in Fig. 8.3.

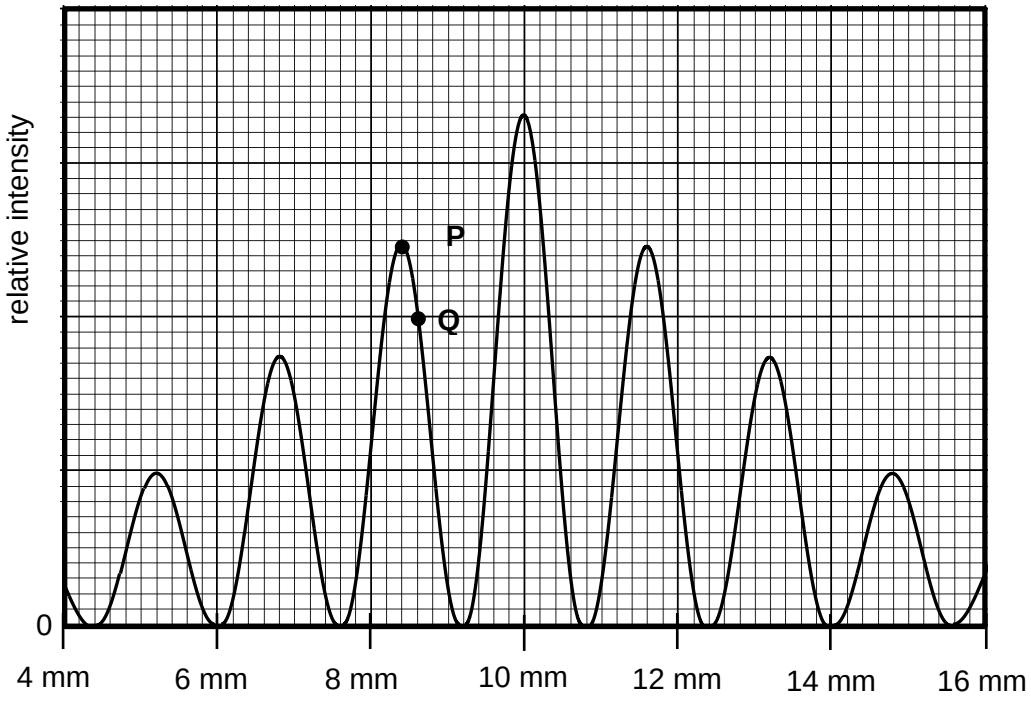

Fig. 8.3

(i) Explain how it can be deduced from Fig. 8.3 that the waves from the two slits are coherent and have the same amplitudes.

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…… [2]

(ii) Calculate the separation a, between the slits.

separation a = …… mm [3]

(iii) State the path difference between the waves from the slits when the waves meet to produce the intensity at point **P** in Fig. 8.3.

path difference = ……... [1]

(iv) Determine the phase difference between the waves from the slits when the waves meet to produce the intensity at point **Q** in Fig. 8.3.

phase difference = …… rad [2]

(v) At a distance of 9.6 mm from the central bright fringe, there is a missing bright fringe due to the single slit diffraction effect.

Calculate the width b, of each slit in the double slit.

width b = …… mm [3]

(c) The double slit is replaced with a diffraction grating as shown in Fig. 8.4. The same light of wavelength 650 nm is incident normally on the grating and a series of bright fringes are observed on the screen.

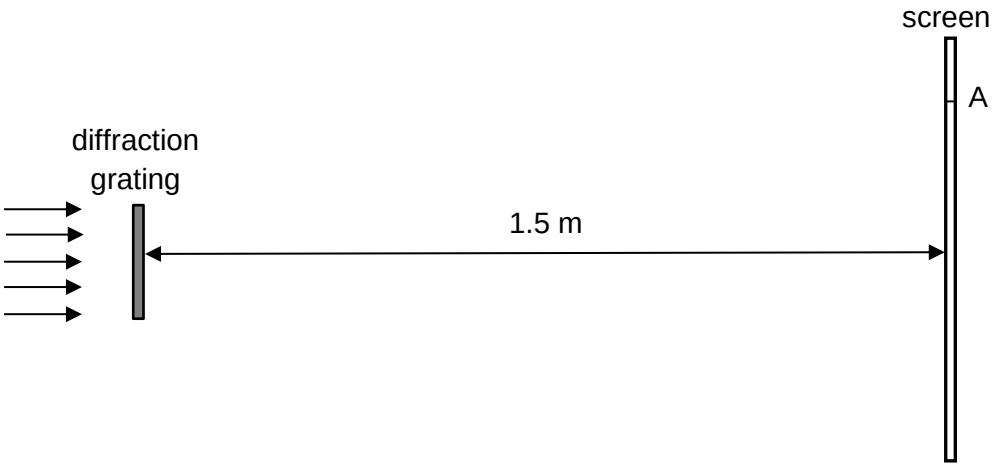

Fig. 8.4

(i) Another light M of a different colour is incident on the grating concurrently with the original light. It is observed that the second order of the original light and the third order of light M overlap at point A.

Calculate the wavelength of light M and hence state its colour.

wavelength = …… nm

colour: ……..… [3]

(ii) The coloured lights are now replaced by a single white light source. Suggest the effects on the appearance of bright fringes observed on the screen.

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…….. [2]