Section B

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

8 **(a) (i)** State what is meant by a *photon*.

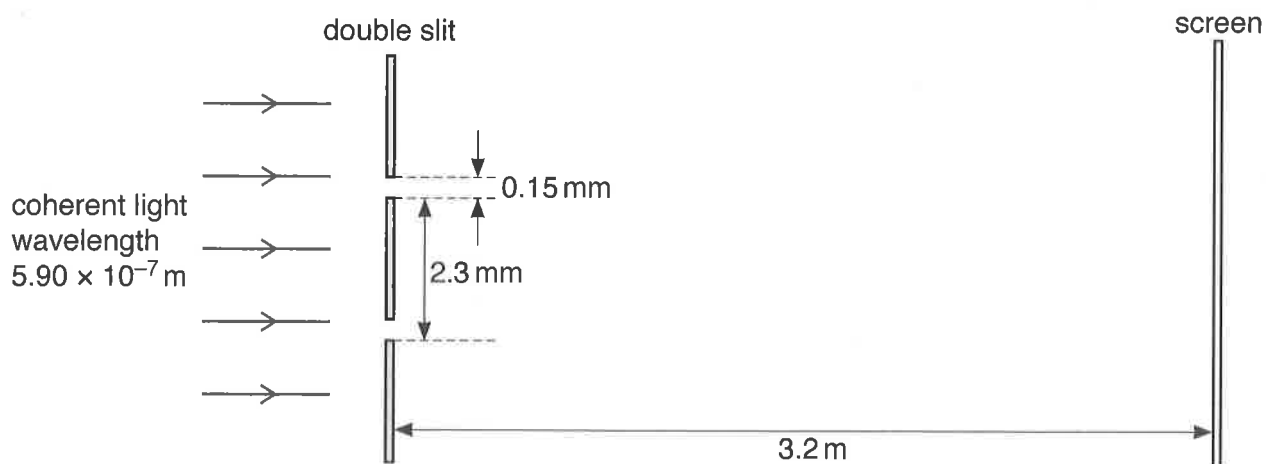...

....

.... [2]

(ii) Explain what is meant by *coherent* light waves.

....

.... [1]

(b) Coherent light of wavelength 5.90×10^{-7} m is incident normally on a double slit, as illustrated in Fig. 8.1.

double slit   screen

coherent light
wavelength
5.90×10^{-7} m

0.15 mm

2.3 mm

3.2 m

Fig. 8.1 (not to scale)

Both slits in the double-slit arrangement are rectangular with a width of 0.15 mm.
The separation of the two slits is 2.3 mm.

A screen is placed parallel to the plane of the double slit at a distance of 3.2 m from the double slit.

(i) Initially, one of the two slits is covered.

Calculate the width of the central bright maximum formed on the screen by diffraction through the uncovered slit.

width = ... m [4]

(ii) State the Rayleigh criterion.

....

....

....

.... [2]

(iii) Both slits in the double slit are now uncovered.

Use the Rayleigh criterion to explain whether the diffraction patterns produced by the two slits are seen on the screen as being separate.

....

....

....

.... [3]

(iv) Calculate the width of a fringe produced by diffraction through the uncovered double slit.

fringe width = ... m [2]

(v) Use your answers to **(b)(i)** and **(b)(iv)** to estimate, to one significant figure, the number of fringes observed in the central bright maximum produced by diffraction at one of the slits.

number = ... [1]

(c) The light of wavelength 5.90×10^{-7} m is now incident normally on a diffraction grating having 750 lines per millimetre.

(i) Determine the angles of diffraction at which maxima of diffracted light are seen.

angles .... [3]

(ii) The diffraction grating is now rotated through a small angle so that the incident light is no longer normal to the grating, as shown in Fig. 8.2. The resulting diffraction pattern is no longer symmetrical.
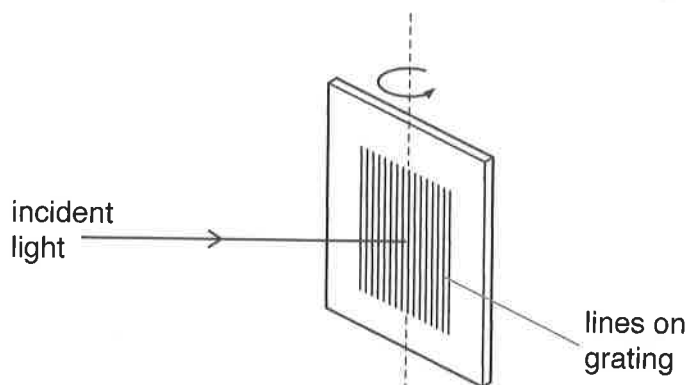

Fig. 8.2

Suggest qualitatively, any other effects on the appearance of the diffraction pattern produced on the screen.

....

....

.... [2]

[Total: 20]