8 (a) (i) State what is meant by a polarized wave.

....

....[2]

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

....[1]

(b) A double slit consists of two parallel slits of the same width *x*. The separation of the slits is 1.40 mm, as illustrated in Fig. 8.1.

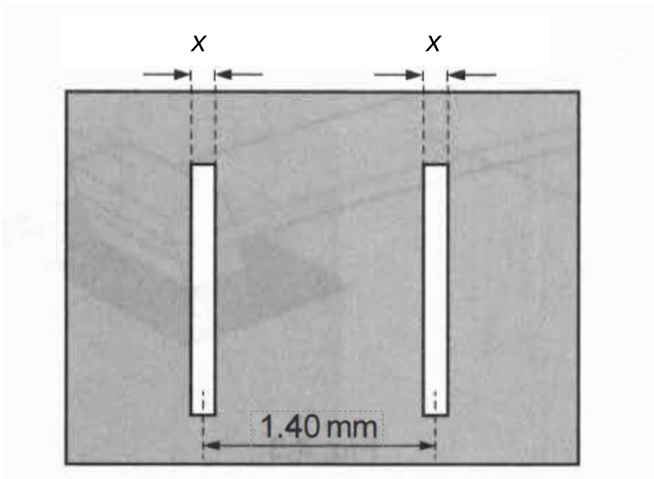

Fig. 8.1

A parallel beam of light of wavelength 590 nm is incident normally on the double slit.

A screen is placed parallel to the plane of the double slit at a distance of 2.60 m from the slits, as illustrated in Fig. 8.2. Point N on the screen is on the central axis of the double slit.

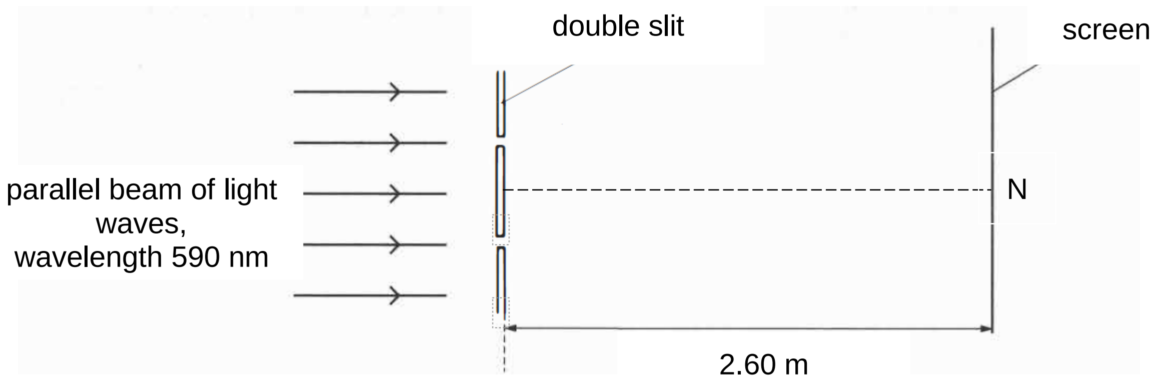

Fig. 8.2

Initially, one of the two slits is covered, and a central maximum of width 30.7 mm is observed on the screen.

(i) Determine *x*.

x = …………………………… m [2]

(ii) Calculate the minimum angular separation between two objects, such that their images can be resolved by the slit.

minimum angular separation = …………………………… rad [2]

(iii) Both slits are now uncovered. Describe how the central maximum changes.

……………………………………………………………………………………………

…………………………………………………………………………………………[2]

(iv) The intensity at point N is I_{single} when one slit is uncovered and I_{double} when both slits are uncovered.

Determine

$$\frac{I_{\text{single}}}{I_{\text{double}}}.$$

$\frac{I_{\text{single}}}{I_{\text{double}}}$ = …………………………… [1]

(v) Another experiment is conducted, where the two slits are replaced by lights from two separate point sources.

Suggest two reasons why the pattern in **(b)(iii)** may not be observed in the new experiment.

1. ....

....

2. ....

.... [2]

(c) Some electron energy levels of the mercury atom are illustrated in Fig. 8.3.

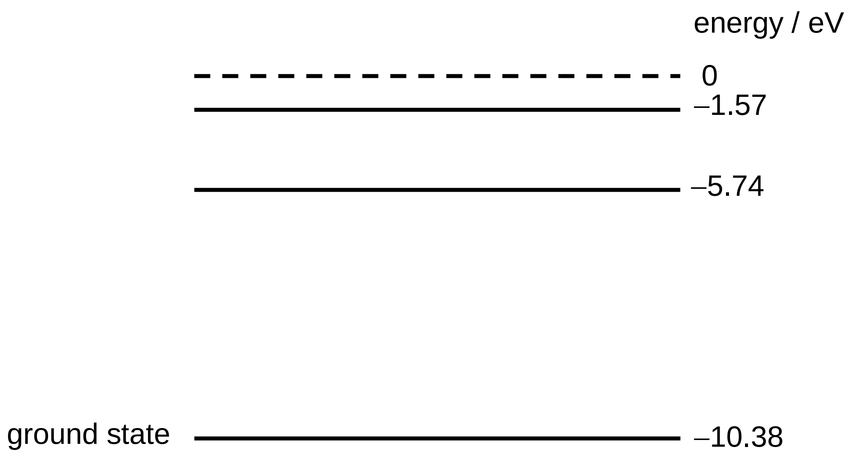

Fig. 8.3 (not to scale)

(i) Explain the significance of the energy levels being negative.

....

.... [1]

(ii) State the ionisation energy of the mercury atom.

ionisation energy = ... eV [1]

(iii) An electron with energy 8.9 eV collides with a mercury atom in its ground state.

Consider only the three energy levels shown in Fig. 8.3.

1. On Fig. 8.3, draw arrows to show electron transitions between energy levels that produce the emission spectrum.

[2]

2. determine the longest wavelength of the spectral lines.

wavelength = ... nm [2]

(iv) A photon with energy 8.9 eV interacts with a mercury atom in its ground state.

For the three energy levels shown in Fig. 8.3, state and explain the number of transition lines in the resulting spectrum.

....

....

....

.... [2]

[Total: 20]