For Examiner's Use

7 **(a)** Explain what is meant by a *progressive transverse* wave.

progressive ....

....

transverse ....

....

.... [3]

(b) State how a polarised transverse wave differs from an unpolarised transverse wave.

....

....

.... [2]

(c) Light is polarised when it passes through a sheet of material known as polaroid.

The component of the displacement of the wave in the direction of polarisation produced by the polaroid is unaffected as the wave passes through the polaroid. The component normal to the direction of polarisation is completely absorbed by the polaroid.

Two sheets of polaroid P and Q are placed close to each other. Their directions of polarisation are parallel to one another, as shown in Fig. 7.1.

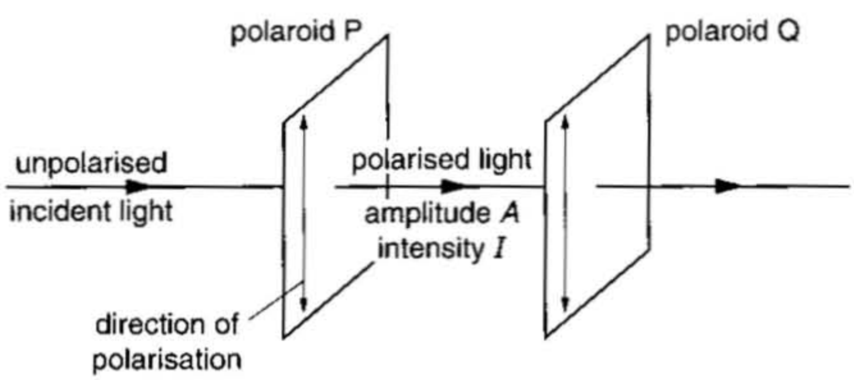

Fig. 7.1

A parallel beam of light passes through polaroid P. The beam, after passing through polaroid P, has amplitude A and intensity I.

The beam then passes through polaroid Q.

For the light transmitted through polaroid Q, state

(i) the amplitude (in terms of A),

amplitude = ...

(ii) the intensity (in terms of I),

intensity = ...

(iii) the relation between the answers to **(i)** and **(ii)**.

....

[2]

(d) The polaroid Q in **(c)** is now rotated about the axis of the light beam, as shown in Fig. 7.2.

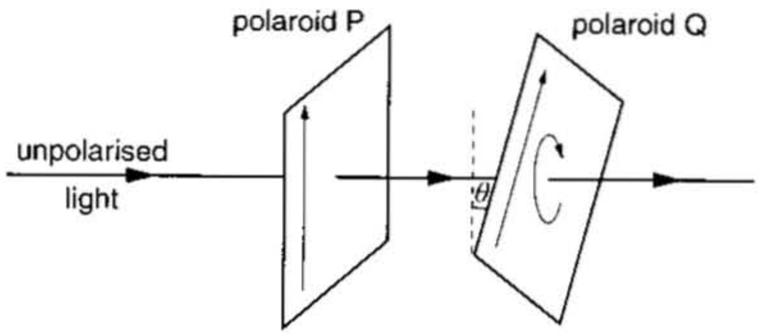

Fig. 7.2

The plane of polaroid Q remains parallel to the plane of polaroid P.

The angle between the direction of polarisation of polaroid P and of polaroid Q is θ.

Complete Fig. 7.3 to show the amplitude, in terms of A, and the intensity, in terms of I, for angle θ equal to 180°, 90° and 60°.

angle θ	amplitude	intensity
180°	....	....
90°	....	....
60°	....	....

Fig. 7.3

[3]

For Examiner's Use

(e) **(i)** State the *principle of superposition.*

....

....

....

.... [3]

(ii) A sound wave passes into a pipe that is open at both ends, as shown in Fig. 7.4.

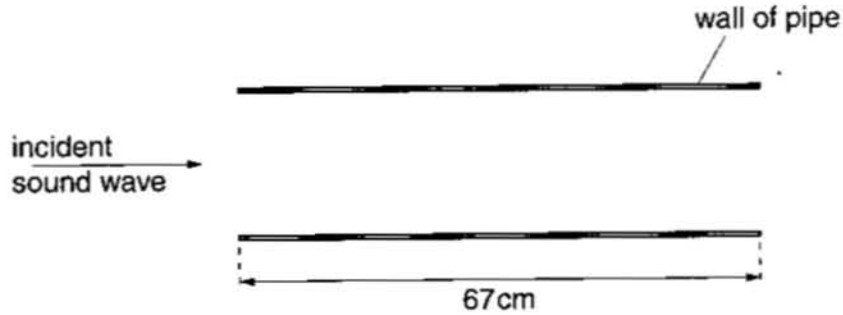

Fig. 7.4

The sound wave travels along the axis of the pipe.

Explain the formation of a stationary (standing) wave in the pipe.

....

....

.... [2]

(f) The frequency of the sound wave in **(e)(ii)** is gradually increased from a low value.

A loud sound is heard in the pipe for the first time at a frequency of 250 Hz.

The length of the pipe is 67 cm.

(i) On Fig. 7.4, mark all the positions of

1. the displacement antinodes (use the letter A),

2. the displacement nodes (use the letter N). [1]

(ii) Calculate a value for the speed of sound in the pipe.

speed = ... $m\,s^{-1}$ [2]

(g) An alternative, more reliable, method of measuring the speed of sound shows that the value in **(f)(ii)** is an underestimate.

For Examiner's Use

This underestimate cannot be attributed to the uncertainty in the measurement of either the frequency or the length of the pipe.

State and explain what can be deduced about the positions of either the nodes or the antinodes of the stationary wave in the pipe.

....

....

.... [2]