Interference

Have a go at the following exam questions.

OCR, G482, JANUARY 2013

5 (a) State the principle of superposition of waves.

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..... **[2]**

(b) Coherent red light of wavelength 6.00×10^{-7} m is incident normally on a pair of narrow slits S_1 and S_2. A pattern of bright and dark lines, called fringes, appears close to point **P** on a distant viewing screen.

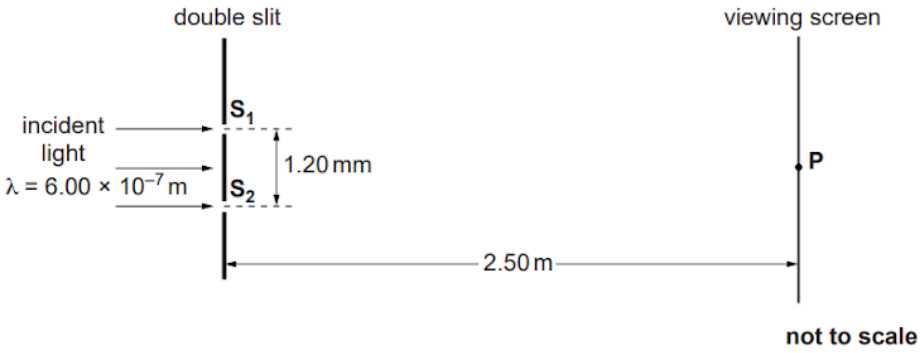

Fig. 5.1

(i) Explain the term *coherent*.

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..... **[1]**

(ii) State a value of the path difference between the light waves from slits S_1 and S_2 to the screen to produce a **dark** fringe on the screen.

path difference = ... m **[1]**

(iii) Calculate the separation of adjacent dark fringes on the screen near to point **P**.

Use the following data: slit separation S_1S_2 = 1.20 mm
distance between slits and screen = 2.50 m

separation = ... m **[3]**

(iv) State and explain the effect, if any, on the **position** of the bright fringes on the screen when each of the following changes is made, separately, to the apparatus.

1 The light source is changed from a red to a yellow light source.

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..... **[2]**

2 Slit S_1 is made wider than slit S_2 but their centres remain the same distance apart.

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..... **[2]**

3 The viewing screen is moved closer to the slits.

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..... **[2]**

[Total: 13]

2. *(a)* (i) (I) Light is a transverse wave. Explain what is meant by a *transverse* wave. [1]

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(II) What is meant by *polarised* light? [1]

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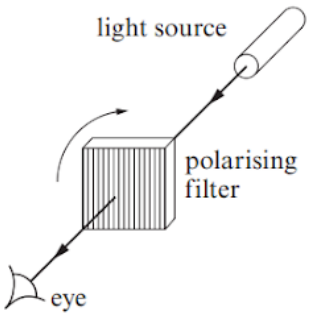
(ii)



Describe what is seen when a source of **polarised** light is viewed through a polarising filter (polaroid) which is rotated slowly as shown through 360°. [2]

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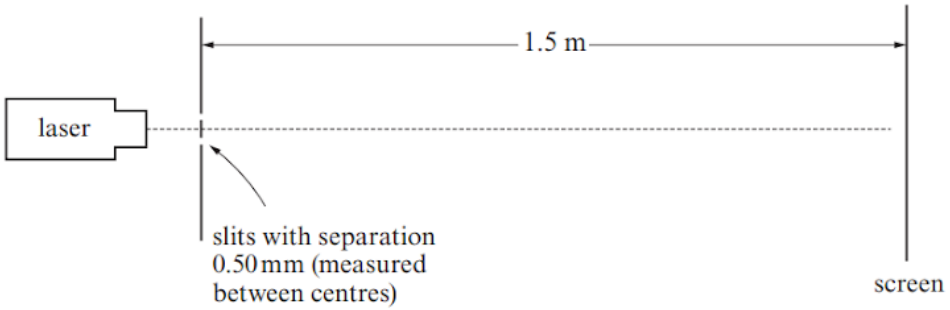
(b) A modern version of Young's *double slit* experiment is set up as shown.



(i) Light *diffracts* at each slit.

(I) What does this statement mean? [1]

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(II) Explain why diffraction at the slits is essential to produce interference fringes. [1]

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(ii) The fringe separation (the separation of the centres of adjacent bright fringes) is 2.0 mm.

(I) Calculate a value for the wavelength of light from the laser. [2]

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(II) The distance from the double slits to the screen is increased to 7.5 m. State **two** ways in which the appearance of the fringes on the screen is changed. [2]

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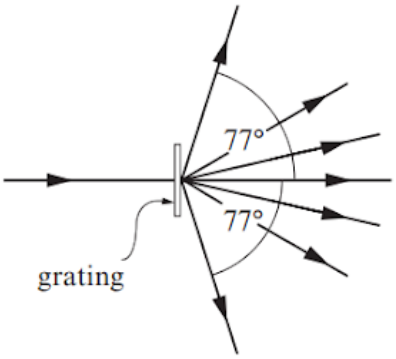
(c)



A diffraction grating with 5.00×10^5 slits per metre is used to measure the wavelength of the laser light, which is shone normally on to the grating. The emerging beams (see diagram) are found to leave the grating as shown.

Calculate the wavelength of the light. [3]

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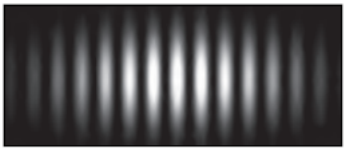
13 Huygens' principle states that every point on a wavefront is a source of wavelets which spread out at the same speed.

(a) State what is meant by a wavefront.

(1)

(b) In an experiment to demonstrate interference of light, monochromatic light from a laser is shone onto two narrow slits. A series of light and dark lines is observed on a screen placed a distance away from the slits.



(i) State one safety precaution that should be taken with this procedure.

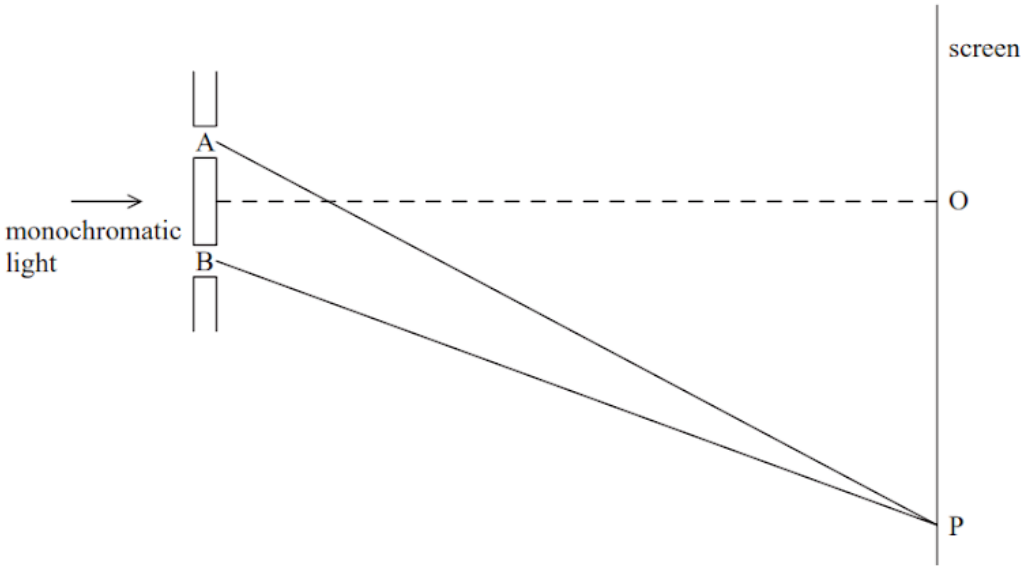
(1)

(ii) Thomas Young first demonstrated the principle of this experiment in 1803 in support of the theory that light behaves as a wave.

Give a reason why some scientists at the time did not accept the wave theory of light.

(1)

(c) The experiment was carried out with laser light of wavelength 600 nm. The diagram below shows two paths taken by the light after it has passed through the two slits A and B. The diagram is not to scale.



(i) Point O is a point equidistant from the two slits.

Explain why there is a bright line at this point.

(3)

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(ii) The next bright line is observed on the screen at point P. Lines AP and BP show the path of the light from each slit to the screen at P.

State the difference in the lengths of the paths AP and BP.

(1)

Difference in lengths of paths = ...

(Total for Question 13 = 7 marks)