Interference Past Paper Questions

Jan 2002 to Jan 2009

1

Q1 Jan 2002

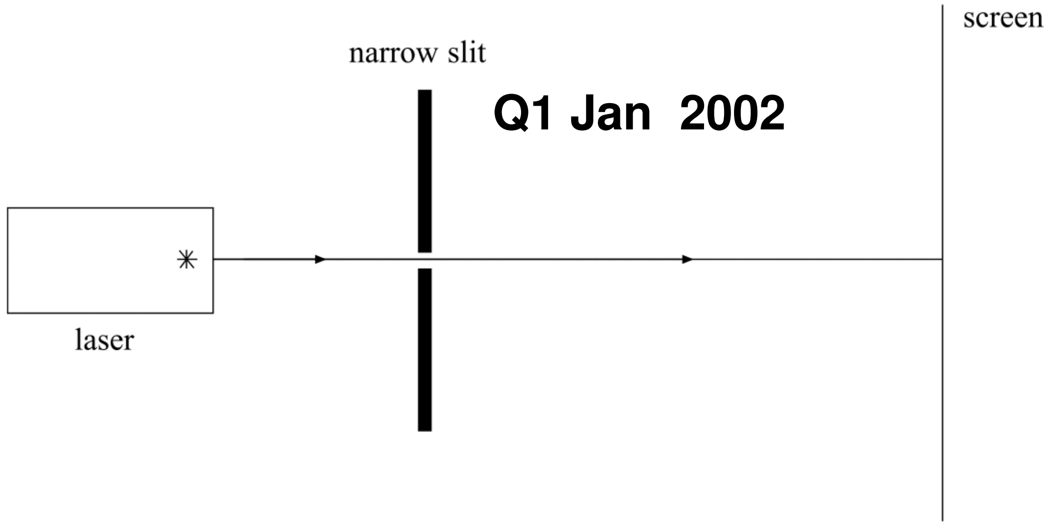


Figure 1

Red light from a laser is passed through a single narrow slit, as shown in **Figure 1**. A pattern of bright and dark regions can be observed on the screen which is placed several metres beyond the slit.

(a) The pattern on the screen may be represented as a graph of intensity against distance along the screen. The graph has been started in outline in **Figure 2.** The central bright region is already shown. Complete this graph to represent the rest of the pattern by drawing on **Figure 2**.

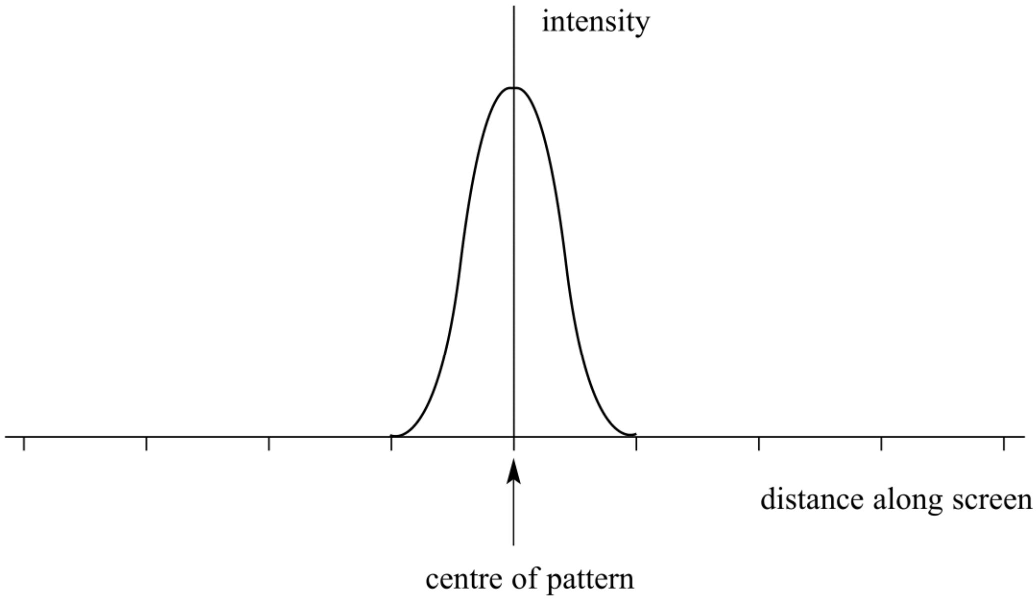


Figure 2

Continued...

(4 marks)

(b) State the effect on the pattern if each of the following changes is made separately.

(i) The width of the narrow slit is reduced.

....

....

....

(ii) With the original slit width, the intense red source is replaced with an intense source of green light.

....

....

....

(3 marks)

2 A vertical screen is placed several metres beyond a vertical double slit arrangement illuminated by a laser. The diagram below shows a full-size tracing of the pattern of spots obtained on this screen. The black patches represent red light whilst the spaces between them are dark.

Q2 Jan 2003

(a) Using the wave theory, explain how the pattern of bright and dark patches is formed.
You may be awarded marks for the quality of written communication provided in your answer.

(3 marks)

(b) The slit separation was 0.90 mm and the distance between the slits and the screen was 4.2 m.

(i) Calculate the spacing of the bright fringes by taking measurements on the diagram of the tracing.

(ii) Hence determine the wavelength of the laser light used.

(4 marks)

2 (a) You may be awarded additional marks to those shown in brackets for the quality of written communication in your answer.

Describe, with the aid of a diagram, the appearance of

2 (a) (i) the interference pattern produced by monochromatic light from a point source after the light has passed through a double slit system,

Q2 Jun 2008

....

....

....

....

....

2 (a) (ii) the diffraction pattern produced by monochromatic light from a point source after the light has passed through a single slit.

....

....

....

....

....

(4 marks)

Continued...

2 (b) Young's fringes, produced by monochromatic laser light passing through slits 0.60 mm apart, are viewed on a screen. The distance across 20 fringe spacings on the screen is 58 mm. When the screen is moved 0.80 m further away from the slits, the distance across 20 fringe spacings becomes 74 mm.

2 (b) (i) Calculate the fringe width in the original arrangement.

....

....

2 (b) (ii) Show that the original distance from the slits to the screen was 2.9 m.

....

....

....

....

....

....

2 (b) (iii) Calculate the wavelength of the laser light.

....

....

....

....

(5 marks)

2 (a) State what is meant by *coherent sources* of light.

Q2 Jun 2005

....

....

....

....

(2 marks)

(b)

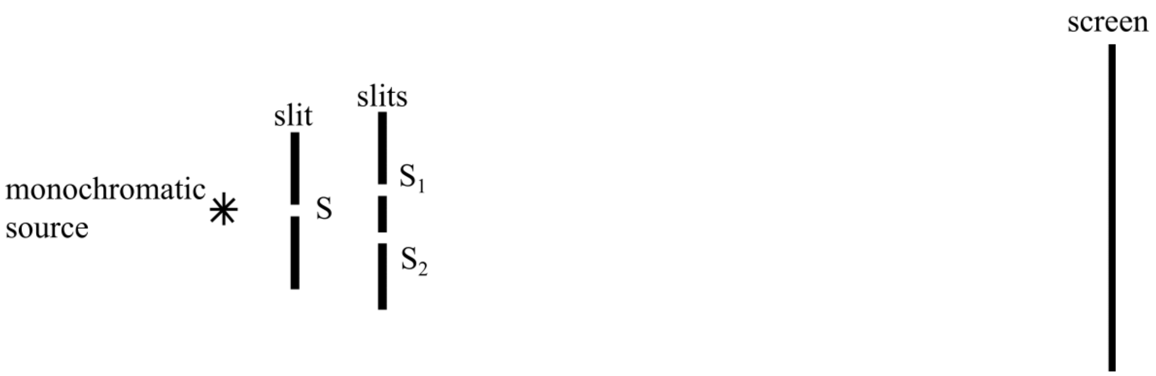


Figure 2

Young's fringes are produced on the screen from the monochromatic source by the arrangement shown in **Figure 2**.

You may be awarded marks for the quality of written communication in your answers.

(i) Explain why slit S should be narrow.

....

....

....

....

(ii) Why do slits S_1 and S_2 act as coherent sources?

....

....

....

....

(4 marks)

Continued...

(c) The pattern on the screen may be represented as a graph of intensity against position on the screen. The central fringe is shown on the graph in **Figure 3**. Complete this graph to represent the rest of the pattern by drawing on **Figure 3**.

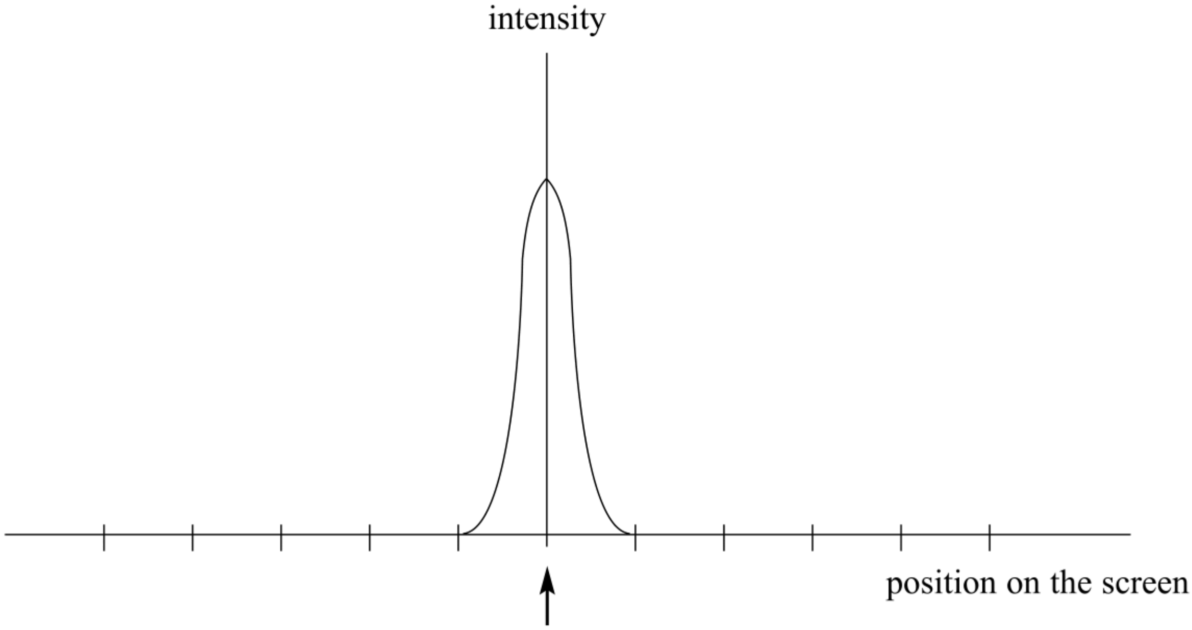


Figure 3

(2 marks)

5 In a double slit interference arrangement the fringe spacing is w when the wavelength of the radiation is λ, the distance between the double slits is s and the distance between the slits and the plane of the observed fringes is D. In which one of the following cases would the fringe spacing also be w?

Q5 Jan 2002

	wavelength	distance between slits	distance between slits and fringes
A	2λ	$2s$	$2D$
B	2λ	$4s$	$2D$
C	2λ	$2s$	$4D$
D	4λ	$2s$	$2D$

5 Which one of the following properties of light waves do polarising sunglasses depend on for their action?

Light waves may

Q5 Jun 2002

A interfere constructively.
B interfere destructively.
C be polarised when reflected from a surface.
D be polarised by the lens in the eye.

6 Interference fringes, produced by monochromatic light, are viewed on a screen placed a distance D from a double slit system with slit separation s. The distance between the centres of two adjacent fringes (the fringe separation) is w. If both s and D are doubled, what will be the new fringe separation?

Q6 Jun 2003

A $\frac{w}{4}$
B w
C $2w$
D $4w$

4 In a Young's double slit interference experiment, monochromatic light placed behind a single slit illuminates two narrow slits and the interference pattern is observed on a screen placed some distance away from the slits. Which one of the following **decreases** the separation of the fringes?

Q4 Jan 2004

A increasing the width of the single slit
B decreasing the separation of the double slits
C increasing the distance between the double slits and the screen
D using monochromatic light of higher frequency

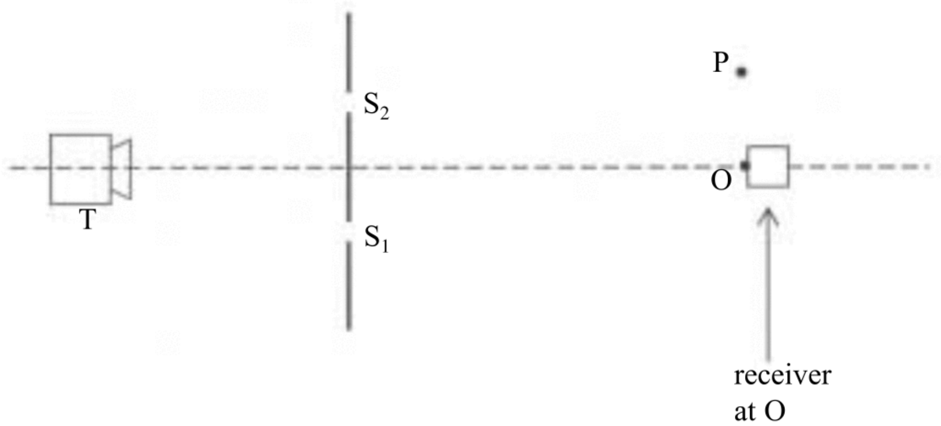
5 Interference maxima produced by a double source are observed at a distance of 1.0 m from the sources. In which one of the following cases are the maxima closest together?

Q5 Jan 2006

A red light of wavelength 700 nm from sources 4.0 mm apart
B sound waves of wavelength 20 mm from sources 50 mm apart
C blue light of wavelength 450 nm from sources 2.0 mm apart
D surface water waves of wavelength 10 mm from sources 200 mm apart

5 The diagram shows a microwave transmitter T which directs microwaves of wavelength λ at two slits S_1 and S_2 formed by metal plates. The microwaves that pass through the two slits are detected by a receiver.

Q5 Jan 2005

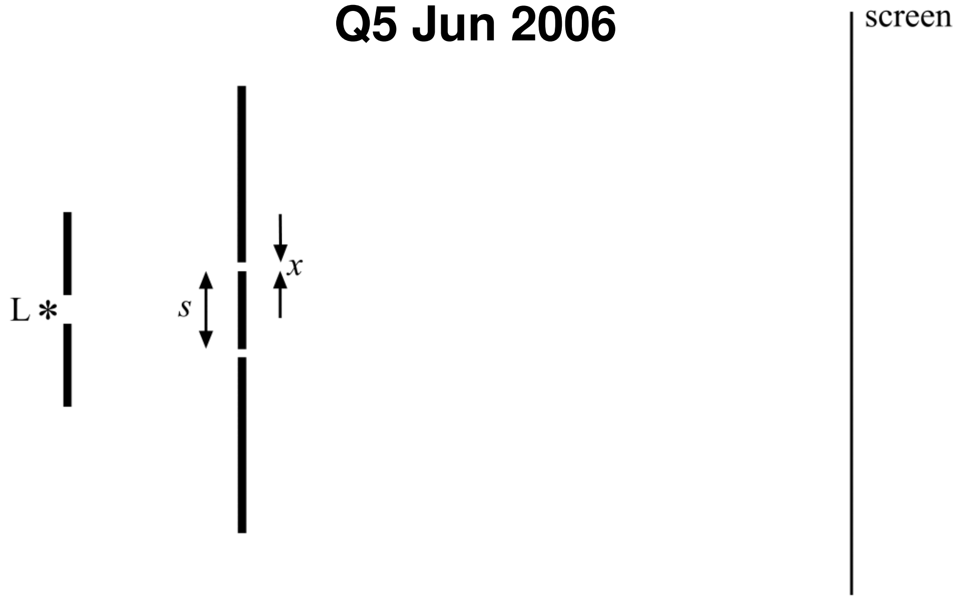


When the receiver is moved to P from O, which is equidistant from S_1 and S_2, the signal received decreases from a maximum to a minimum. Which one of the following statements is a correct deduction from this observation?

A The path difference $S_1O - S_2O = 0.5\lambda$
B The path difference $S_1O - S_2O = \lambda$
C The path difference $S_1P - S_2P = 0.5\lambda$
D The path difference $S_1P - S_2P = \lambda$

5

Q5 Jun 2006



In a double slit system used to produce interference fringes, the separation of the slits is s and the width of each slit is x. L is a source of monochromatic light. Which one of the following changes would **decrease** the separation of the fringes seen on the screen?

A moving the screen closer to the double slits
B decreasing the width, x, of each slit, but keeping s constant
C decreasing the separation, s, of the slits
D exchanging L for a monochromatic source of longer wavelength

5 Interference fringes are produced on a screen by illuminating a double slit with monochromatic light. Which one of the following changes would reduce the separation of these fringes?

Q5 Jan 2008

A increasing the separation of the slits
B increasing the distance from the screen to the slits
C increasing the wavelength of the light
D increasing the width of an individual slit

6 Two coherent sources produce waves which are 180° out of phase. What is a possible value for the path difference of the two waves when they meet at a point of constructive interference, if the wavelength is λ?

Q6 Jan 2008

A 0

B $\frac{\lambda}{4}$

C $\frac{\lambda}{2}$

D λ

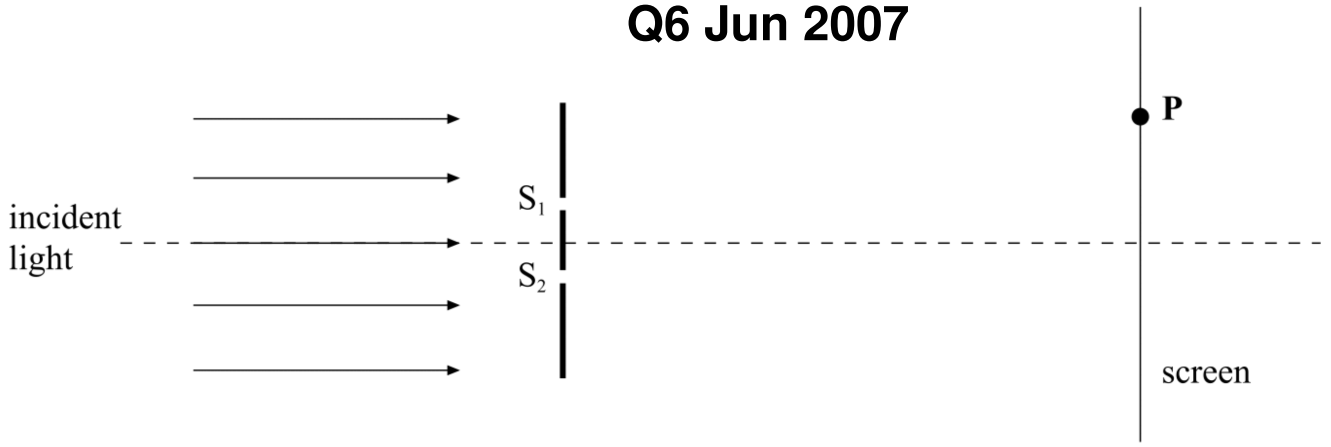
5 In order to produce interference effects with visible light, coherent sources must be used. The waves produced by these sources do **not** need to have the same

Q5 Jun 2007

A amplitude.
B frequency.
C wavelength.
D photon energy.

6 When a parallel beam of monochromatic light of wavelength λ is directed at two narrow slits, S_1 and S_2, interference fringes are observed on a screen.

Q6 Jun 2007



Which line, **A** to **D**, in the table gives the conditions for a dark fringe at point **P** on the screen? (m in the table represents an integer.)

	path difference $S_2P - S_1P$	**phase difference between waves at P**
A	$m\lambda$	0
B	$(m + \frac{1}{2})\lambda$	180°
C	$m\lambda$	180°
D	$(m + \frac{1}{2})\lambda$	0