Diffraction Past Paper Questions

Jan 2002 to Jan 2009

Q1 Jun 2004

1 **Figure 1** shows a section of a diffraction grating. Monochromatic light of wavelength λ is incident normally on its surface. Light waves diffracted through angle θ form the **second** order image after passing through a converging lens (not shown). **A**, **B** and **C** are adjacent slits on the grating.

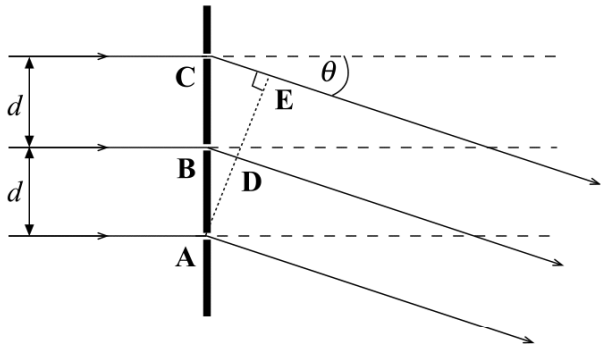

Figure 1

(a) (i) State the phase difference between the waves at **A** and **D**.

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(ii) State the path length between **C** and **E** in terms of λ.

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(iii) Use your results to show that, for the second order image,
$2\lambda = d \sin \theta$,
where d is the distance between adjacent slits.

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(3 marks)

Continued.....

(b) A diffraction grating has 4.5×10^5 lines m^{-1}. It is being used to investigate the line spectrum of hydrogen, which contains a visible blue-green line of wavelength 486 nm. Determine the highest order diffracted image that could be produced for this spectral line by this grating.

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(2 marks)

2 (a) When a parallel beam of monochromatic light is incident normally on a diffraction grating, light leaving the grating has maxima of intensity in particular directions. Explain the parts played by *diffraction* and *interference* in the production of these maxima.

Q2 Jan 2007

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(3 marks)

(b) Light consisting of two wavelengths, the shorter of which is 420 nm, is incident normally on a grating. At a diffraction angle of 44°, the third order maximum produced by light of one wavelength coincides exactly with the second order maximum produced by light of the other wavelength.

(i) Show that the other wavelength is 630 nm.

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(ii) Calculate the number of lines per metre on the grating.

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(iii) Determine the highest order maximum that can be observed with the 420 nm wavelength.

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(5 marks)

7 Using a diffraction grating with light of wavelength 500 nm incident normally, a student found the second order diffracted maxima in a direction at 30° to the central bright fringe. What is the number of lines per metre on the grating?

Q7 Jun 2007

A 2×10^4

B 2×10^5

C 4×10^5

D 5×10^5

7 Light of wavelength λ is incident normally on a diffraction grating of slit separation 4λ. What is the angle between the second order maximum and third order maximum of the diffracted light?

Q7 Jan 2008

A 14.5°
B 18.6°
C 48.6°
D 71.4°

5 Light of wavelength 590 nm is incident normally on a diffraction grating with 500 lines per mm.

What is the maximum number of orders that will be observed in the light emerging from the grating?

Q5 Jun 2008

A 2
B 3
C 4
D 5

6 Using a diffraction grating with monochromatic light of wavelength 500 nm incident normally, a student found the 2nd order diffracted maxima in a direction at 30° to the central bright fringe. What is the number of lines per metre on the grating?

Q6 Jan 2002

A 2×10^4

B 2×10^5

C 4×10^5

D 5×10^5

6 Monochromatic light of wavelength 590 nm is incident normally on a plane diffraction grating having 4×10^5 lines m^{-1}. An interference pattern is produced. What is the highest order visible in this interference pattern?

Q6 Jun 2002

A 2

B 3

C 4

D 5

7 A narrow beam of monochromatic light falls on a diffraction grating at normal incidence. The second order diffracted beam makes an angle of 45° with the grating. What is the highest order visible with this grating at this wavelength?

Q7 Jun 2003

A 2
B 3
C 4
D 5

5 Light of wavelength λ is incident normally on a diffraction grating of slit separation 4λ. What is the angle between the second order maximum and third order maximum?

Q5 Jan 2004

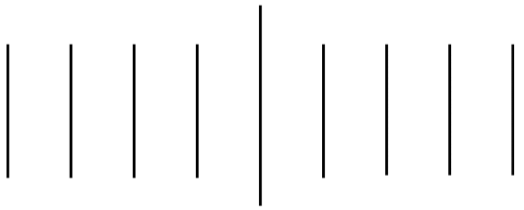
A 14.5°
B 18.6°
C 48.6°
D 71.4°

6 Light of wavelength λ is incident normally on a diffraction grating for which adjacent lines are a distance 3λ apart. What is the angle between the second order maximum and the straight-through position?

A 9.6°
B 20°
C 42°
D There is no second order maximum.

Q6 Jun 2005

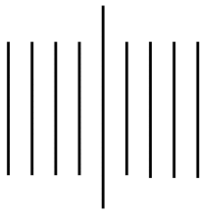
6



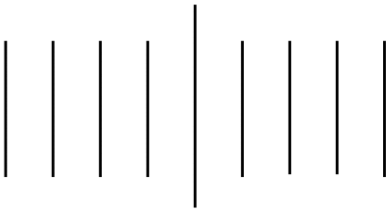
Q6 Jun 2006

The diagram above shows the first four diffraction orders each side of the zero order when a beam of monochromatic light is incident normally on a diffraction grating of slit separation *d*. All the angles of diffraction are small. Which one of the patterns, **A** to **D**, drawn on the same scale, is obtained when the grating is exchanged for one with a slit separation $\frac{d}{2}$?

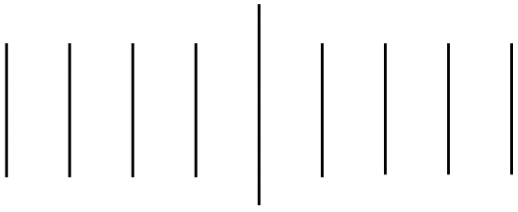
A



B



C



D