

# Diffraction Past Paper Questions

Jan 2002 to Jan 2009

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

Q1 Jun 2004

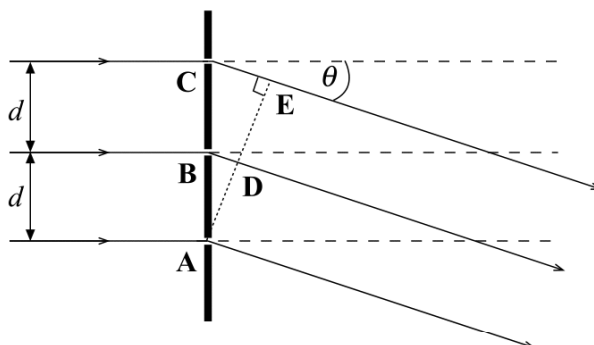


Figure 1

- (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  $\lambda$ .

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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  $4.5 \times 10^5$  lines  $\text{m}^{-1}$ . 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  $44^\circ$ , 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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**Continued.....**

- (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  $30^\circ$  to the central bright fringe. What is the number of lines per metre on the grating?

- A  $2 \times 10^4$
- B  $2 \times 10^5$
- C  $4 \times 10^5$
- D  $5 \times 10^5$

**Q7 Jun 2007**

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

- A  $14.5^\circ$
- B  $18.6^\circ$
- C  $48.6^\circ$
- D  $71.4^\circ$

**Q7 Jan 2008**

- 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?

- A 2
- B 3
- C 4
- D 5

**Q5 Jun 2008**

- 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  $30^\circ$  to the central bright fringe. What is the number of lines per metre on the grating?

A  $2 \times 10^4$

B  $2 \times 10^5$

C  $4 \times 10^5$

D  $5 \times 10^5$

**Q6 Jan 2002**

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

A 2

B 3

C 4

D 5

**Q6 Jun 2002**

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

A 2

B 3

C 4

D 5

**Q7 Jun 2003**

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

A  $14.5^\circ$

B  $18.6^\circ$

C  $48.6^\circ$

D  $71.4^\circ$

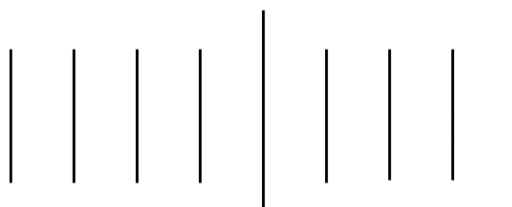
**Q5 Jan 2004**

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

- A  $9.6^\circ$
- B  $20^\circ$
- C  $42^\circ$
- D There is no second order maximum.

**Q6 Jun 2005**

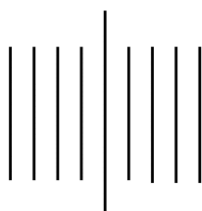
6



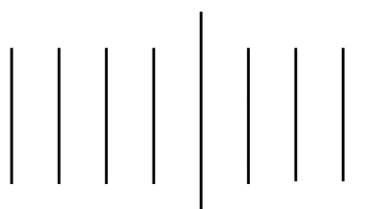
**Q6 Jun 2006**

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  $\frac{d}{2}$ ?

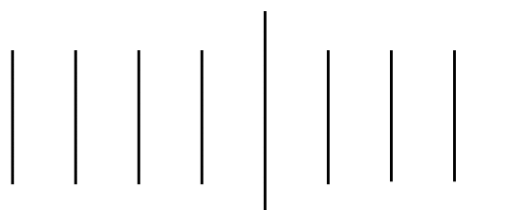
**A**



**B**



**C**



**D**

