Cambridge Assessment International Education

Interactive

Interactive Example Candidate Responses
Paper 2 (May/June 2016), Question 5
Cambridge International AS & A Level Physics 9702

Version 1.0

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HIGH | MIDDLE | LOW

5 (a) Light of a single wavelength is incident on a diffraction grating. Explain the part played by *diffraction* and *interference* in the production of the first order maximum by the diffraction grating.

diffraction: It is the spreading of waves through a narrow gap or opening.

interference: Interference is the overlapping of waves when they meet at a common point. These waves must be coherent, of the same type and polarised in the same plane.

[3]

(b) The diffraction grating illustrated in Fig. 5.1 is used with light of wavelength 486 nm.

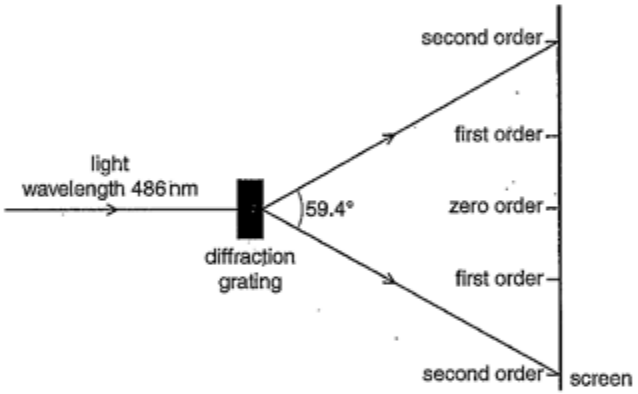

Fig. 5.1 (not to scale)

The orders of the maxima produced are shown on the screen in Fig. 5.1. The angle between the two second order maxima is 59.4°.

Calculate the number of lines per millimetre of the grating.

$\frac{59.4}{2} = 29.7°$

$d \sin\theta = n\lambda$

$d \sin 29.7° = 2(4.86 \times 10^{-7})$

$\therefore d = 1.96 \times 10^{-6}$ m

$d = \frac{1}{N}$

$1.96 \times 10^{-6} = \frac{1}{N}$

$\therefore N = 509731$ line

$\therefore N = 509731140$ (m) (mm)

number of lines per millimetre = 509731140 mm^{-1} [3]

[Total: 6]

Your Mark

5(a) ☐

5(b) ☐

Q5	Mark scheme		
(a)	diffraction: spreading/diverging of waves/light (takes place) at (each) slit/element/gap/aperture	B1	
	interference: overlapping of waves (from coherent sources at each element)	B1	
	path difference λ/phase difference of 360(°)/2π (produces the first order)	B1	**[3]**
(b)	$d \sin\theta = n\lambda$ **or** $\sin\theta = N n\lambda$	C1	
	$d = (2 \times 486 \times 10^{-9}) / \sin 29.7° (= 1.962 \times 10^{-6})$	C1	
	number of lines = 510 (509.7) mm^{-1}	A1	**[3]**
			[Total: 9]

EXAMINER COMMENTS | MARK SCHEME

Select page

HIGH | MIDDLE | LOW

5 (a) Light of a single wavelength is incident on a diffraction grating. Explain the part played by *diffraction* and *interference* in the production of the first order maximum by the diffraction grating.

diffraction: The wave experience a bending due to meeting an aperture or obstacle

interference: When two or more waves meet at a point, the displacements add up, and there is a change in displacement.

[3]

(b) The diffraction grating illustrated in Fig. 5.1 is used with light of wavelength 486 nm.

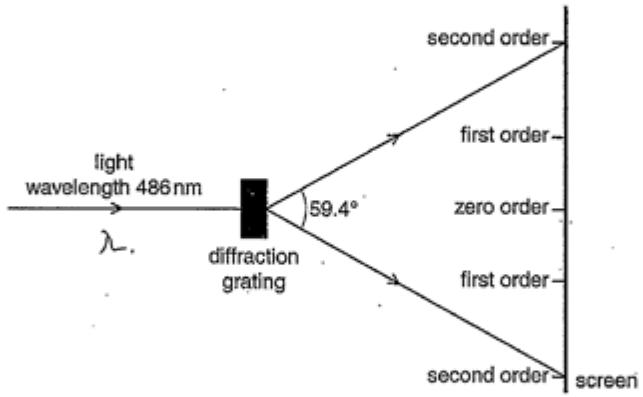

Fig. 5.1 (not to scale)

The orders of the maxima produced are shown on the screen in Fig. 5.1. The angle between the two second order maxima is 59.4°.

Calculate the number of lines per millimetre of the grating.

$D \sin\theta = n\lambda$

$D = \frac{2 \times 486 \times 10^{-9}}{\sin(\frac{59.4°}{2})}$

$D = \frac{1.43}{1.96 \times 10^{-6}}$ ~~No~~

number of lines per millimetre = ... mm^{-1} [3]

[Total: 6]

Your Mark

5(a) ☐

5(b) ☐

Q5	Mark scheme		
(a)	diffraction: spreading/diverging of waves/light (takes place) at (each) slit/element/gap/aperture	B1	
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	number of lines = 510 (509.7) mm^{-1}	A1	**[3]**
			[Total: 9]

EXAMINER COMMENTS

MARK SCHEME

Select page

HIGH | MIDDLE | LOW

5 (a) Light of a single wavelength is incident on a diffraction grating. Explain the part played by *diffraction* and *interference* in the production of the first order maximum by the diffraction grating.

diffraction: This is when the light wave gets spreaded out or we can say when it bends on the edges.

interference: This is when the two waves meet at this point they may form a constructive interference or destructive interference.

[3]

(b) The diffraction grating illustrated in Fig. 5.1 is used with light of wavelength 486 nm.

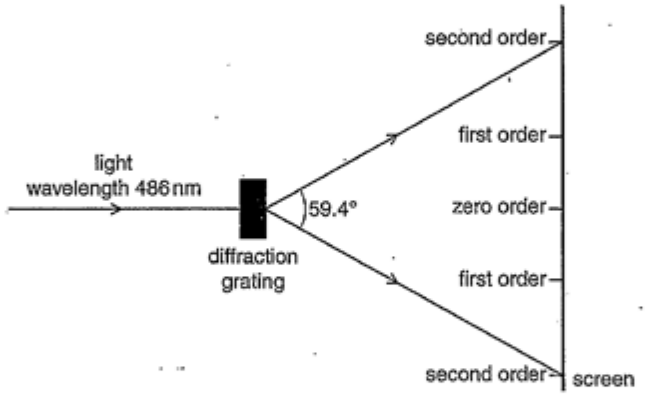

Fig. 5.1 (not to scale)

The orders of the maxima produced are shown on the screen in Fig. 5.1. The angle between the two second order maxima is 59.4°.

Calculate the number of lines per millimetre of the grating. $\lambda = 486$

$d \sin\theta = n\lambda$

$d \sin 59.4 = 2 \times 486$

$d = 1129.3$ $\qquad \frac{1}{1129.3} = 8.85 \times 10^{-4}$

number of lines per millimetre = 8.85×10^{-4} mm^{-1} [3]

Your Mark

5(a) ☐

5(b) ☐

Q5	Mark scheme		
(a)	diffraction: spreading/diverging of waves/light (takes place) at (each) slit/element/gap/aperture	B1	
	interference: overlapping of waves (from coherent sources at each element)	B1	
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	number of lines = 510 (509.7) mm^{-1}	A1	**[3]**
			[Total: 9]

EXAMINER COMMENTS

MARK SCHEME

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