2023 Ph H1 Q15

Section: Particles and Waves

Topic: Interference

Question Summary

Monochromatic light of wavelength 605 nm passes through a diffraction grating with slit spacing 5.0×10^{-6} m. Maxima are observed up to 29° from the centre. What is the total number of maxima on the screen?

Worked Solution

Diffraction grating condition: $d \sin\theta = m\lambda$.

Given $d = 5.0 \times 10^{-6}$ m, $\lambda = 605$ nm $= 6.05 \times 10^{-7}$ m.

Maximum order $m_{max} = d \sin\theta / \lambda$.

$m_{max} = (5.0 \times 10^{-6} \times \sin 29°) / (6.05 \times 10^{-7})$.

$\sin 29° \approx 0.485$.

$m_{max} \approx (2.425 \times 10^{-6}) / (6.05 \times 10^{-7}) \approx 4.01$.

So maximum observable order = 4 (integer).

Maxima occur for $m = 0, \pm 1, \pm 2, \pm 3, \pm 4 \rightarrow$ total = 9.

Final Answer

D — 9 maxima

Revision Tips

• Use $d \sin\theta = m\lambda$ to find maximum possible m.

• Round m_{max} down to nearest integer.

• Remember to count both positive and negative orders, plus central maximum.

- Total = 2m_max + 1.