OCR (B) Physics A-level

PAG 05.1 - Determining the Wavelength of Light using a Diffraction Grating

Practical Flashcards

What safety precautions should be taken when operating a laser?

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- Never look directly at the beam
- Ensure no reflective surfaces are in the laser's vicinity
- Display a warning notice so others know that a laser is in use

Why should the screen you use to display the interference patterns on have a matt finish?

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A matt screen should be used to reduce the likelihood of the laser beam reflecting from the screen into someone's eye and causing harm.

What is monochromatic light?

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Monochromatic light, is light of a single wavelength (or frequency).

What does it mean if two light sources are coherent?

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Coherent sources have the same wavelength and a constant phase difference.

What happens to light as it passes through a slit?

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Light diffracts as it passes through a slit, with the maximum diffraction occurs when the slit spacing matches the light's wavelength.

Why do bright fringes form on a screen when light is passed through a diffraction grating?

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The light diffracts as it passes through the slits and these diffracted waves meet and undergo superposition. At positions where the waves meet in phase, constructive interference occurs, and bright fringes are formed.

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What equation is used to determine the wavelength of light when using a diffraction grating?

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$$n\lambda = d \sin\theta$$

n: order of diffraction pattern

λ: wavelength

d: diffraction grating spacing

θ: angle from centre

How is a diffraction grating spacing calculated?

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The diffraction grating spacing is the reciprocal of the number of lines per metre.

How can the angle from the centre to a higher order line be calculated?

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The distance from the diffraction grating to the screen (D) and the distance from the centre of the pattern to the higher order line (h) can be measured. The angle is then given by trigonometry.

How does a diffraction pattern from a double slit experiment compare to one from a diffraction grating?

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As the number of slits increases, the pattern becomes sharper and the brightness of the fringes increases. This is because more rays are reinforcing the pattern.

Suggest a use for a diffraction grating.

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Diffraction gratings can be used instead of prisms to analyse spectra. An example use is in X-ray crystallography.

Where will the zero order maximum be positioned?

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The zero order maximum will be found on the screen, straight ahead of the laser beam, once it has passed through the diffraction grating.

Describe the nature of the light emitted by a laser.

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Lasers produce monochromatic, coherent light that is collimated (consists of parallel rays).

Describe the interference pattern produced if white light is passed through the diffraction grating.

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A central bright white fringe will be produced. All other bright fringes would consist of a spectra of light, with blue light on the side closest to the centre, and red on the far side of each fringe.

Why does the interference pattern from white light consist of spectra?

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White light is a mix of all other colours and so contains light of lots of different wavelengths. Each wavelength of light will be diffracted by a slightly different amount, resulting in spectra forming in all but the central fringe.