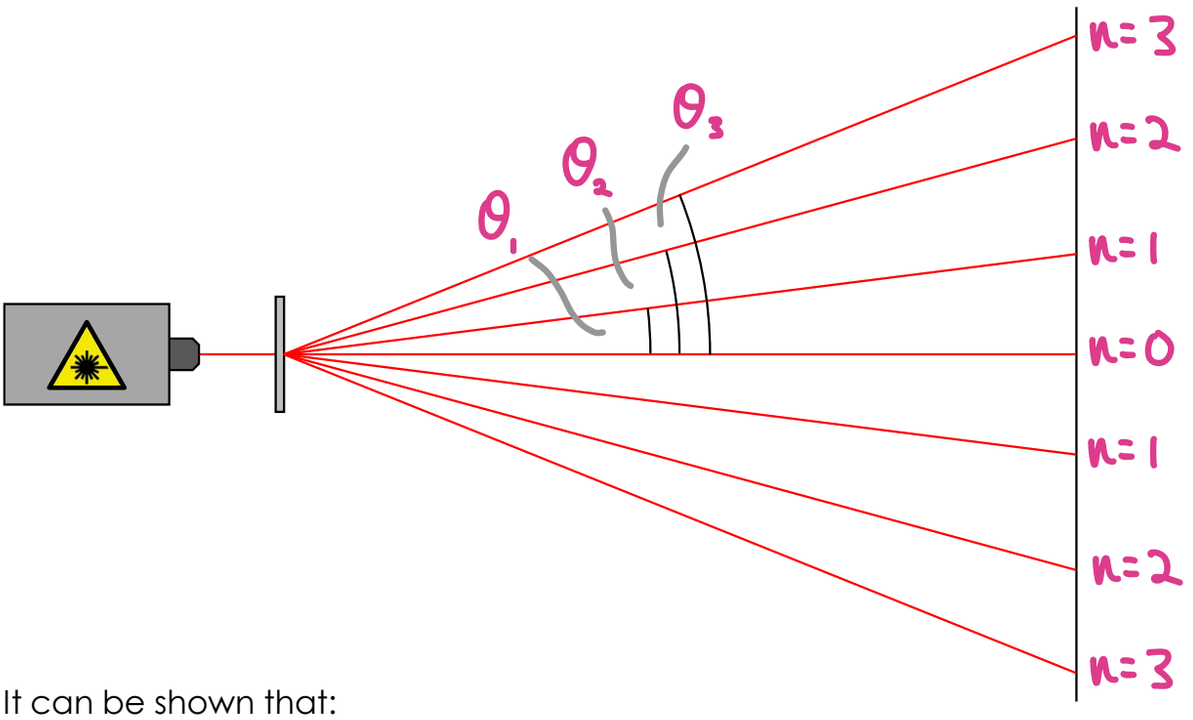
Diffraction Grating

A Level
Practical Notes

Theory: Light displays wave-like properties. As it travels through an aperture (gap) approximately equal in size to its wavelength, it will diffract and spread out.

When a coherent source of waves passes through multiple slits next to each other, the many diffracted waves will interfere - leading to regions of constructive and destructive interference. This can be seen with a series of widely spaced bright spots on a screen.



It can be shown that:

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

Where: d is the distant between gratings

n is the order of the maxima

θ is the angle between the maxima and the zeroth order

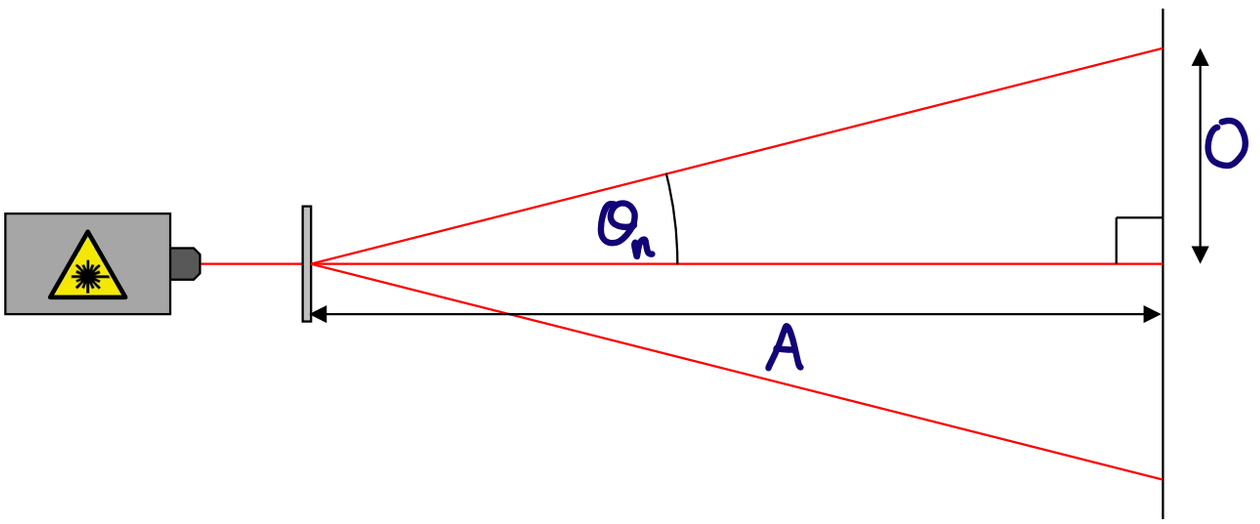
λ is the wavelength

Risks and Hazards

Lasers: Lasers can cause permanent eye damage. Do not look directly into the beam and avoid specular reflections from shiny surfaces.

Method 1. Measuring the Wavelength of Laser Light

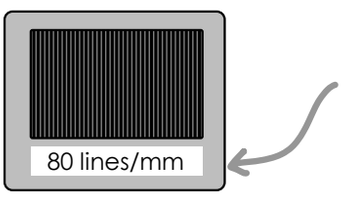
To investigate the interference of monochromatic (single wavelength) laser light through a diffraction grating the following equipment can be set up:



A laser (with a power less than 1 mW) is securely clamped, pointing at a diffraction grating held in position just in front of it. A piece of paper attached to a vertical surface acts as a screen.

To minimise errors in the measurement of the distance between maxima, it is best to carry out the experiment in a darkened room.

The number of lines per millimetre is usually printed on the diffraction grating itself. This must be converted into the distance between each grating in metres. The angle θ can be calculated from the distance to the screen and the distance between bright spots.



$$d = \frac{1}{80 \times 10^3} \qquad \theta = \tan^{-1}\frac{O}{A}$$

A value for the wavelength of light can be determined. This can be compared to the value of the laser used - a typical red laser produces light at about 630 nm. The effect of different gratings on the pattern produced could also be investigated.

Teacher and Technician Notes

- The wavelength of the laser measured in this experiment can be compared to the stated value on the laser. It can also be compared/contrasted to the practical where a double slit is used to diffract the light.

- Lasers are commonly used in cheap laser pointers at work and for cat toys at home, but they must be treated with caution in school. CLEAPSS guidance PS52 advises that school science departments only use lasers of BS EN 60825 Class 1 or 2 that are below 1 mW.

- Be aware that some red lasers bought online (and many green, blue and purple lasers) are incorrectly labelled and have an actual output greater than 1 mW. CLEAPSS recommends purchasing fully assembled Class 1 or Class 2 lasers from reputable suppliers. If you are unsure, then contact CLEAPPS for guidance.

Suitable Equipment

IPC-2588-L Semiconductor Laser

VTN12302461

This sits firmly on the table, has a key to turn it on and a lens cover. It is Class 2, less than 1 mW and has a stated wavelength of 630 nm.

Slide with Diffraction Grating

VTN12302470

Part of a slide kit with multiple other gratings and slits.

Lascells Slide Carrier

VTN12302465

This sits on the desk and holds the diffraction grating vertical.

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