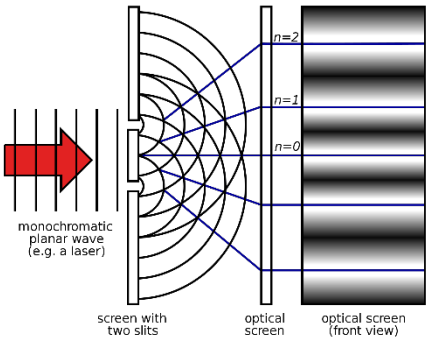
Edexcel Physics A Level

Core Practical 8

Determine the Wavelength of light

Method 1: Double-slit Experiment



- Shine monochromatic light (same wavelength) through 2 slits and to produce 2 coherent wave sources
    - If you use 2 sources the two waves will not be coherent
    - Slits must be small enough to cause the diffraction of light and close enough to allow interference
- The coherent waves will interfere as they overlap
    - Points of constructive interference form bright fringes on the screen
    - Points of destructive interference form dark fringes on the screen
- Measure the slit to screen distance, D, in metres
- Measure the slit to slit distance, a, in metres
- Measure the fringe separation, x
- Calculate the wavelength as followed:

$$\lambda = \frac{ax}{D}$$

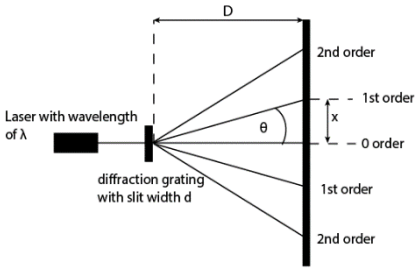
Safety

- Do not look into the laser, can cause eye damage

Evaluation

- Conduct experiment in a darkened room as the light intensity is low, so the fringes are difficult to see
- In polychromatic (white) light, each colour has own set of fringes which overlap to blurred fringes, but the edges of the fringe can be sharpened using a colour filter
    - This provides more accurate values of x
- Reduce percentage uncertainty in x by measuring across all fringes and diving by the no. of fringes
- Increase slit to screen distance to increase fringe separation (but this reduces the intensity of light reaching the screen)

Method 2: Diffraction Grating



- Set up equipment as shown above with the diffraction grating at right angles to the light from the laser, parallel to the screen
- Find the slit width which is $\frac{1}{\text{slits per metre value}}$
- Measure the distance, D, between grating and the screen with a metre rule
- Measure the distance, x, by measuring the distance between the first orders and diving by 2 (to get the mean x between the 1st order and 0th order)
- Using small angle approximations, find θ ($\theta \approx xD$)
- ENSURING YOUR CALCULATOR IS IN RADIANS – find wavelength using:

$$\lambda = \frac{d\sin\theta}{n}$$

  - λ – Wavelength of light (m)
  - d – Slit width
  - θ – Beam angle
  - n – Order used (e.g. for 1st order, n=1)
- Repeat for more order lines to get an average of wavelength
- Repeat for a diffraction grating with a different number of slits per metre and average

Safety

- Do not look into the laser, can cause eye damage

Evaluation

- If slit width is bigger (less slits/metre) the pattern will not spread out as much
  - if d is larger, Sinθ is smaller so, individual maxima are sharper
- Place laser far enough from diffraction grating that a good spread of diffraction patterns can be seen
- Conduct experiment in a dark room
- Use a Vernier scale to record x, in order to reduce percentage uncertainty
- Larger grating to screen distance makes all x values greater, so reduces uncertainty
- Measure from nth order on one side to other nth order on other side, so distance measured larger so lower percentage uncertainty in x
- Use grating with more lines per mm, so values of x greater so lower percentage uncertainty