(c) if $D$ increases $\Delta y$ also increases for fixed $\lambda$ and vice-versa.

(d) if the source slit $S_O$ is widened the fringes gradually disappear. The slit $S_O$ then equivalent to large number of narrow slits, each producing its own fringe system at different places. The bright and dark fringes of different systems therefore overlap, giving rise to a different illumination.

(e) if one of the slit, $S_1$ or $S_2$ is covered up, the fringes disappear.

(f) if the source slit $S_O$ is moved nearer the double slits, $\Delta y$ is unaffected but their intensity increases.

(g) if the experiment is carried out in a different medium, for example water, the fringe separation $\Delta y$ decreased or increased depending on the wavelength, $\lambda$ of the medium.

(h) if white light is used the central bright fringe is white, and the fringes on either side are coloured. Blue is the colour nearer to the central fringe and red is farther away as shown in figure below.

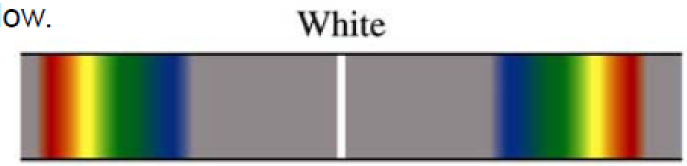


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Table below shows the range of wavelength for colours of visible light.

| Colour | Range of $\lambda$/nm |
|---|---|
| Violet | 400 – 450 |
| Blue | 450 – 520 |
| Green | 520 – 560 |
| Yellow | 560 – 600 |
| Orange | 600 – 625 |
| Red | 625 - 700 |

## Example 1:

In a Young's double experiment, the slits separation is 1.0 mm. The distance between the slits and the screen is 1.0 m. The wavelength of the sodium light used is 5.9 x $10^{-5}$ cm.

a. Calculate the separation between two consecutive dark fringes.

b. If the sodium light is replaced with a blue light, what is the changes to the interference pattern on the screen?

Solution: $d = 1 \times 10^{-3}\ m,\ D = 1.0\ m,\ \lambda = 5.9 \times 10^{-7}\ m$

a. By applying the formula below,

$$\Delta y = \frac{\lambda D}{d}$$

$$\Delta y = 5.9x10^{-4}\ m$$

b. Sodium light is yellow

$$\lambda_{blue} < \lambda_{yellow} \quad \text{and} \quad \Delta y = \frac{\lambda D}{d},\ \textit{where } D \text{ and } d \text{ are constant}$$

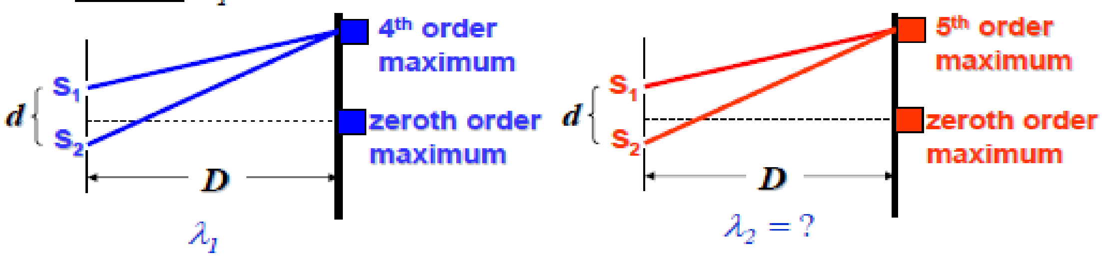
$$\Delta y_{blue} < \Delta y_{yellow}$$

hence, **the fringes get closer to each other.** 28

## Example 2:

A monochromatic light of wavelength 600 nm falls on a system of double-slits of unknown slit separation. At the same time, the double-slits is illuminated by a monochromatic light of unknown wavelength. It was observed that the 4th order maximum of the known wavelength light overlapped with the 5th order maximum of the unknown wavelength light. Find the wavelength of the unknown wavelength light.

Solution: $\lambda_1 = 600 \times 10^{-9}\ m$




By applying the separation from central bright fringe for maximum (bright) fringe, thus

$$y_m = \frac{mD\lambda}{d}$$

For 4th order maximum :

$$y_4 = \frac{4D\lambda_1}{d}$$

For 5th order maximum :

$$y_5 = \frac{5D\lambda_2}{d}$$

Because the fringe is overlap, thus

$$y_4 = y_5$$

$$\frac{4D\lambda_1}{d} = \frac{5D\lambda_2}{d}$$

$$\lambda_2 = 4.8x10^{-7}\ m \quad or\ 480\ nm$$