

Superposition of waves.

Q-1) What is phase difference?

- > Phase difference is the displacement of the particles when they vibrate out of phase (difference in angles).

$$\frac{2\pi (360^\circ)}{\text{Phase difference}} = \frac{\lambda}{\text{Path difference}}$$

Q-2) What is the principle of superposition of waves?

- > When 2 waves meet at a point, the resultant displacement is the vector sum of the displacement of the individual waves.

Q-3) What is interference?

- > The variation in the intensity of the resultant wave due to the superposition of 2 waves at a point is called interference.

Constructive interference

Destructive interference

① displacements add up

① displacements subtract/cancel.

② intensity is higher

② intensity is lower

③ path difference =  $n\lambda$

③ path difference =  $(n + \frac{1}{2})\lambda$

④ phase difference =  $2n\pi$

④ phase difference =  $(2n + 1)\pi$

⑤ point at which they meet

⑤ point at which they meet is a

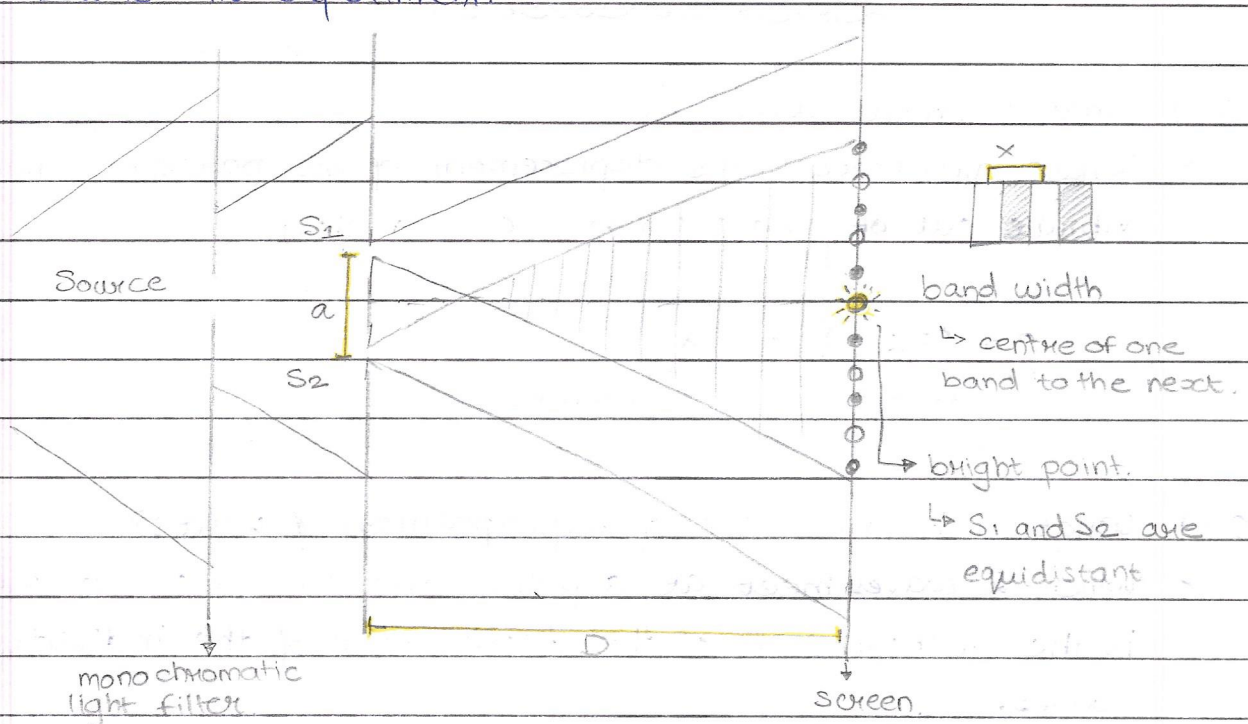
is a ~~dark~~ <sup>bright</sup> point

dim/dark point.

### General conditions for interference:

- \* 2 sources of light must be coherent. - have constant phase difference
  - ↳ same source (original source)
- \* Wavelength should be the same.
- \* Frequency doesn't change for coherent sources.
- \* sources should be close to each other

Q-4) Double slit experiment.



can be measured with a travelling microscope

distance between sources & screen.

$$x = \frac{D \lambda}{a}$$

band width      a - distance between 2 sources.

When 2 waves coming from 2 coherent sources overlap / superimpose, there is constructive and destructive interference, forming bright & dark spots on the screen.

Conditions.

- \* width of the slit should be fraction of a mm  
↳ otherwise v. little light would come out.
- \* the 2 sources should be 1mm apart  
↳ further apart = narrower band width, so it would be difficult to separate the fringes.
- \* Distance from source to screen should be 1 metre.  
↳ so the waves overlap.
- \* sources should be coherent.

### Ideal conditions.

- \* If the amplitude of the 2 waves is the same:
  - bright spots will be maximum bright
  - dark spots will be completely dark.
- \* Use a laser because
  - it's highly monochromatic (focused - doesn't scatter).
  - ∴ bands will be brighter & clearer.
  - & more no. of fringes will form
  - distance 'D' can be increased
  - ∴ band width will increase so it can be measured more accurately.

Q-5) What is diffraction?

- > Diffraction is the bending of waves around the corners of obstacles and the spreading of waves into regions of geometric shadows.

For maximum diffraction, the size of obstacle / width of slit should be comparable to the wavelength of the wave.

Q-6) What is a diffraction grating?

- > A diffraction grating consists of a glass slide with many equally spaced lines to diffract light.

→ The fringes are also known as maxima.

\* the first is called 0 zeroth-order maximum.

the next one first-order maximum and so on...

distance of adjacent grating lines.

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

angle of diffraction      order of diffraction.

\* for maximum 'n' the angle is 90°

\* no. of lines observed = 2n + 1.