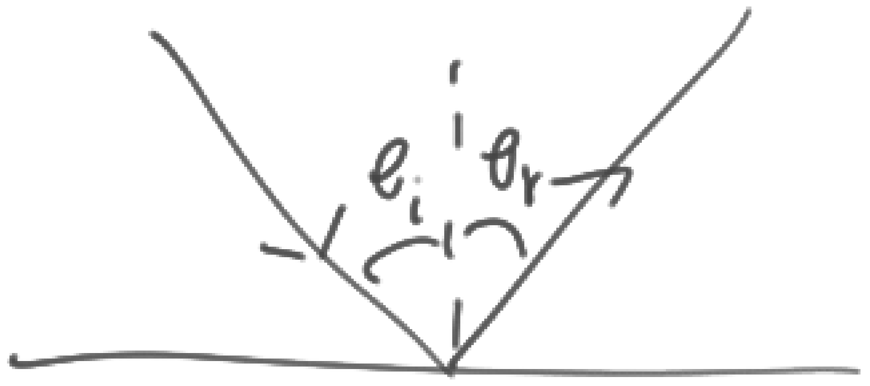
Wave phenomena

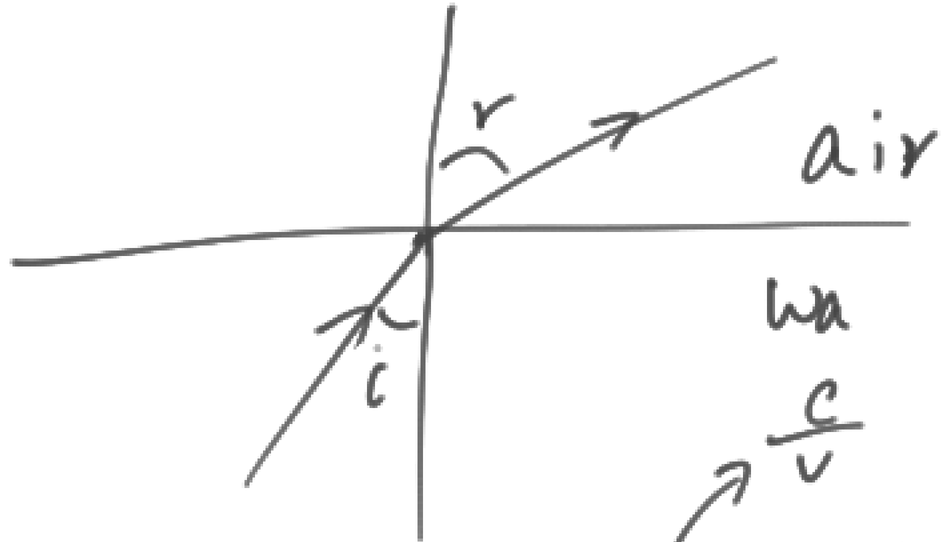
① Reflection



$\theta_i = \theta_r$

② Refraction

change in wave speed when changing medium



$\frac{c}{v}$

$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1} = \frac{v_1}{v_2} = \frac{\cancel{f}\lambda_1}{\cancel{f}\lambda_2}$$

Total internal reflection

① $\theta_i > \theta_c$

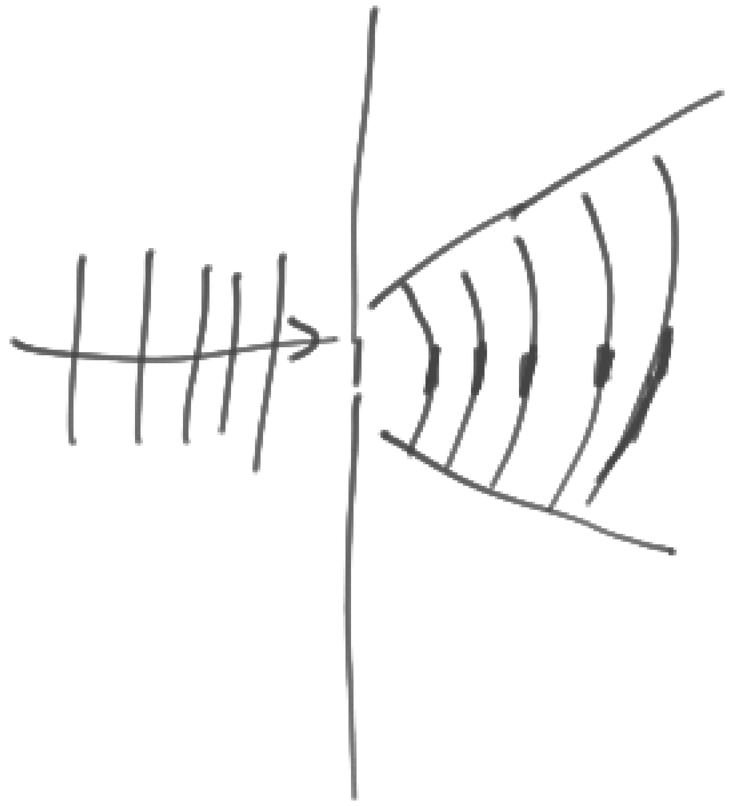
② Travel from dense to less dense medium (v increases)

f doesn't change.

v changes usually

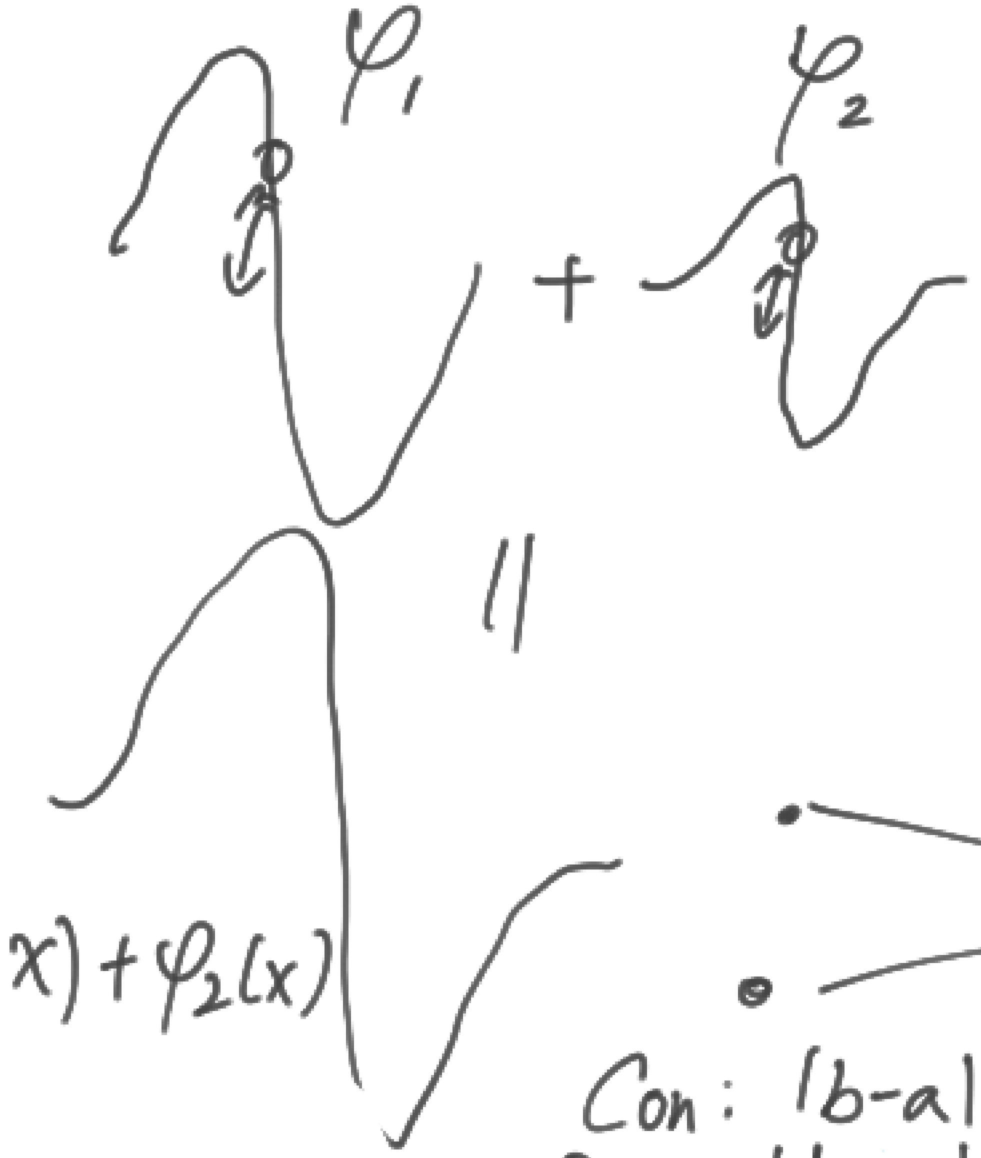
∴ increased / decreased λ

③ Diffraction

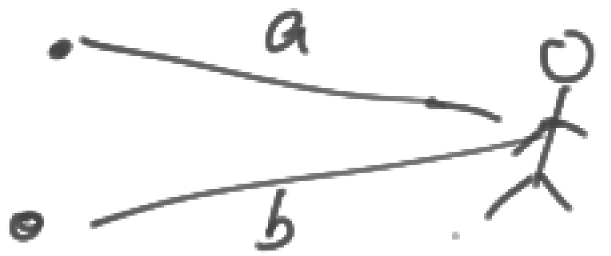


④ interference

Superposition



$\Delta x = \varphi_1(x) + \varphi_2(x)$

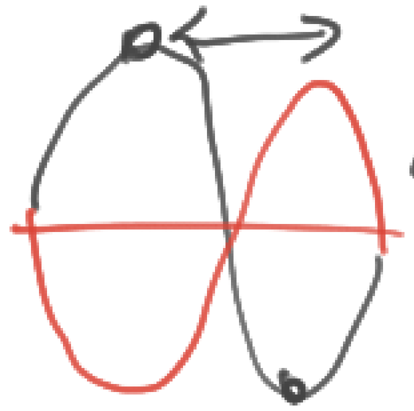


Con: $|b-a| = m\lambda$

Des: $|b-a| = (m+\frac{1}{2})\lambda$

Destructive

$A = (2n+1)\pi$



Constructive

$A = 2n\pi \Rightarrow A = 2A_0$

① Coherent*:

Same frequency

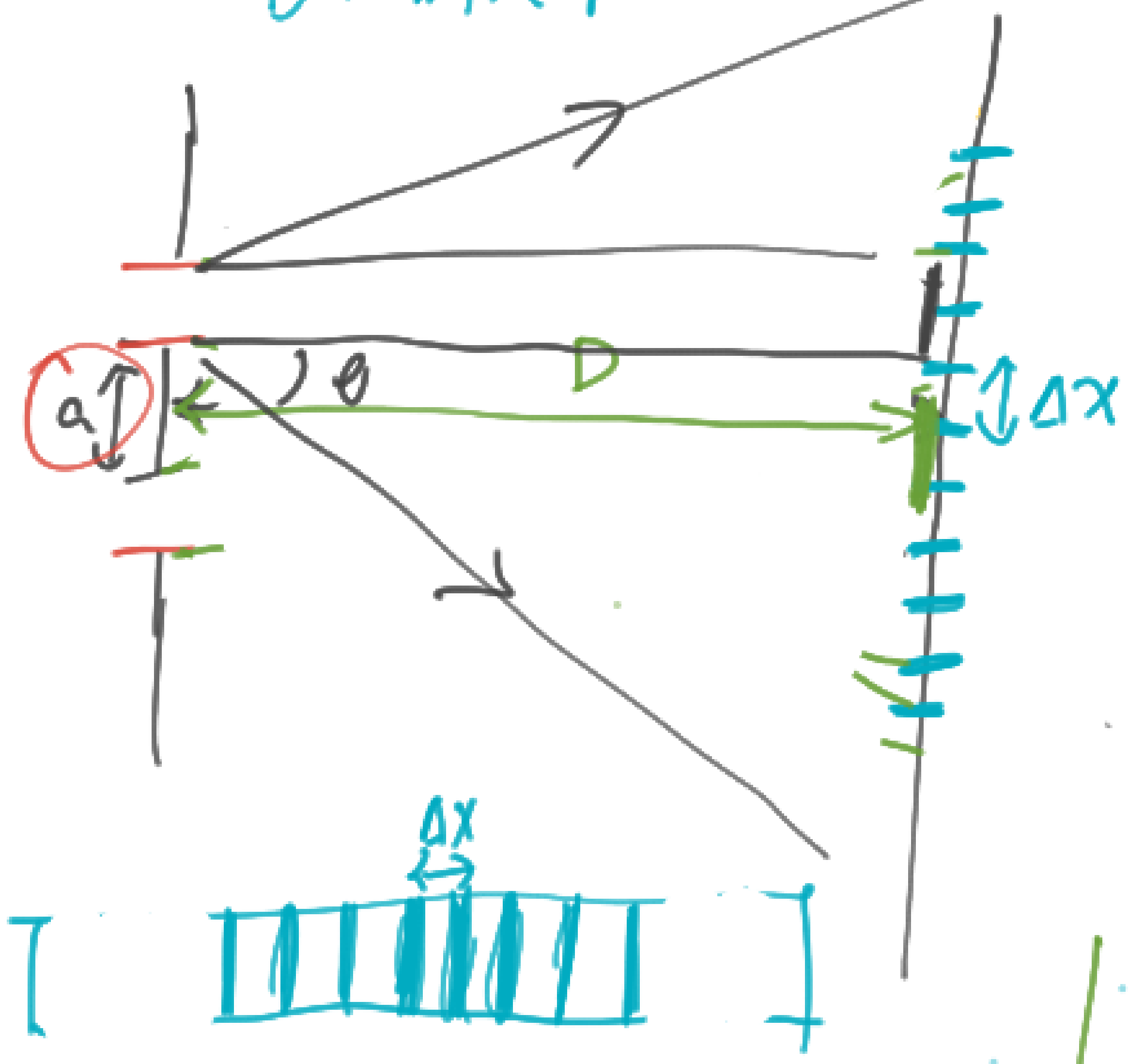
Constant phase relationship

Double slit & Diffraction grating

Double slit ..

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

$D\uparrow \ \Delta x\uparrow \quad a\uparrow \ \Delta x\downarrow$



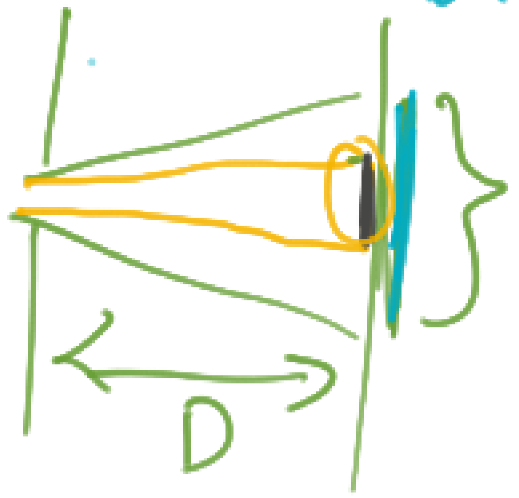
if slit width of double slit increases

→ Δx DOES NOT CHANGE!

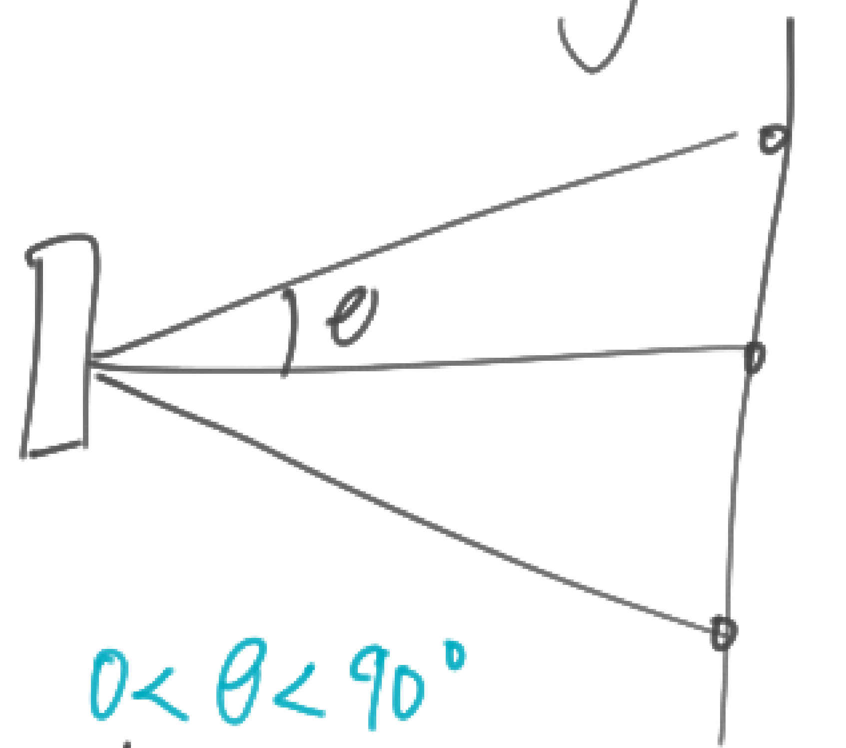
→ Degree of diffraction decreases

① Central bright fringes increase in brightness

② Total amount of bright fringes decreases



Diffraction grating

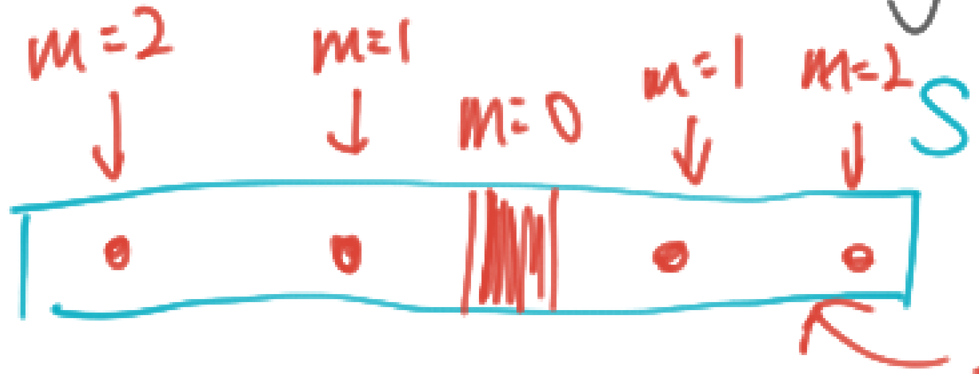


$0 < \theta < 90°$

$$d\sin\theta = m\lambda$$

d: line spacing on grating

m: order of maximum



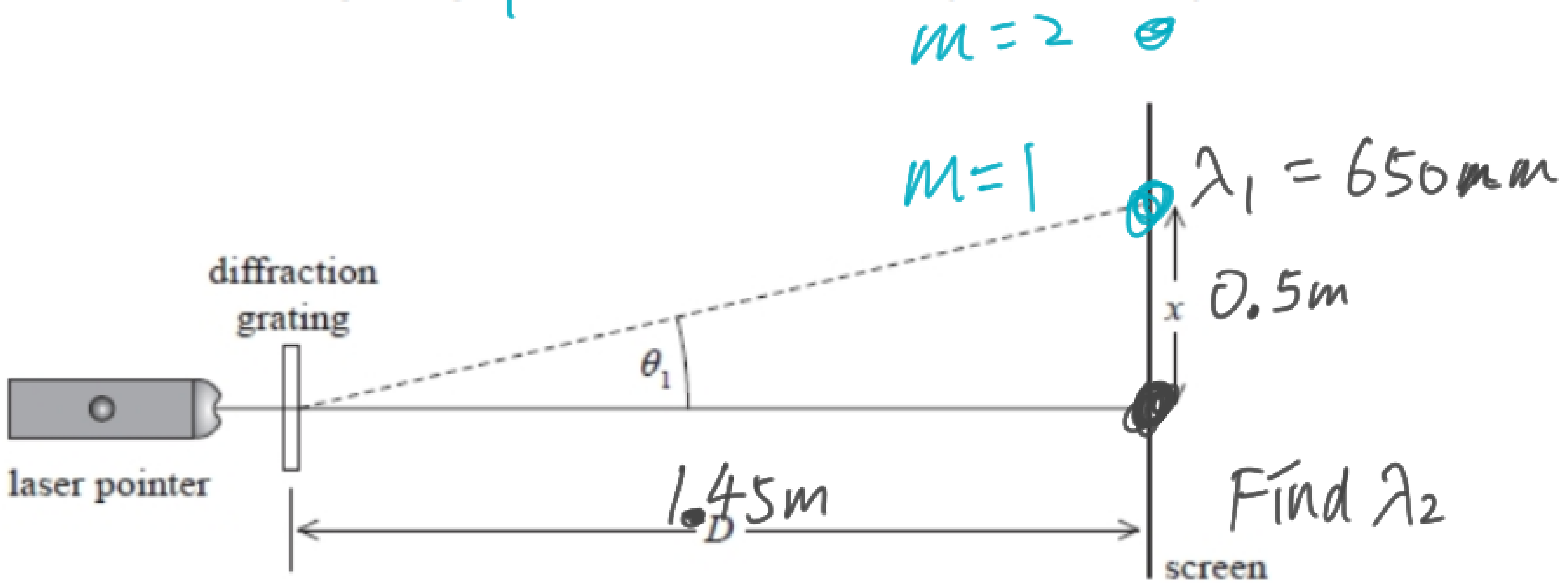
$\sin\theta \leq 1 \rightarrow \frac{m\lambda}{d} \leq 1$

$m \leq \frac{d}{\lambda}$

$\frac{d}{\lambda} = 2.5$

Q4.

Light from a laser pointer was passed through a diffraction grating. The light was perpendicular to the diffraction grating as shown. A diffraction pattern was produced on a screen.



The distance between the $\boxed{\text{first}}$ order maximum and the central maximum of the diffraction pattern was x. The distance between the diffraction grating and the screen was D.

Distance x was measured to be 0.500 m with a metre rule. The wavelength of light λ_1 from the laser pointer was 650 nm.

The laser pointer was replaced with one that produced light of a λ_2 different wavelength. The new distance x was measured to be 0.400 m.

D = 1.45 m

Calculate the wavelength λ_2 of the light emitted by the replacement laser pointer.

(5)

λ_1:

$d \sin\theta_1 = m\lambda$

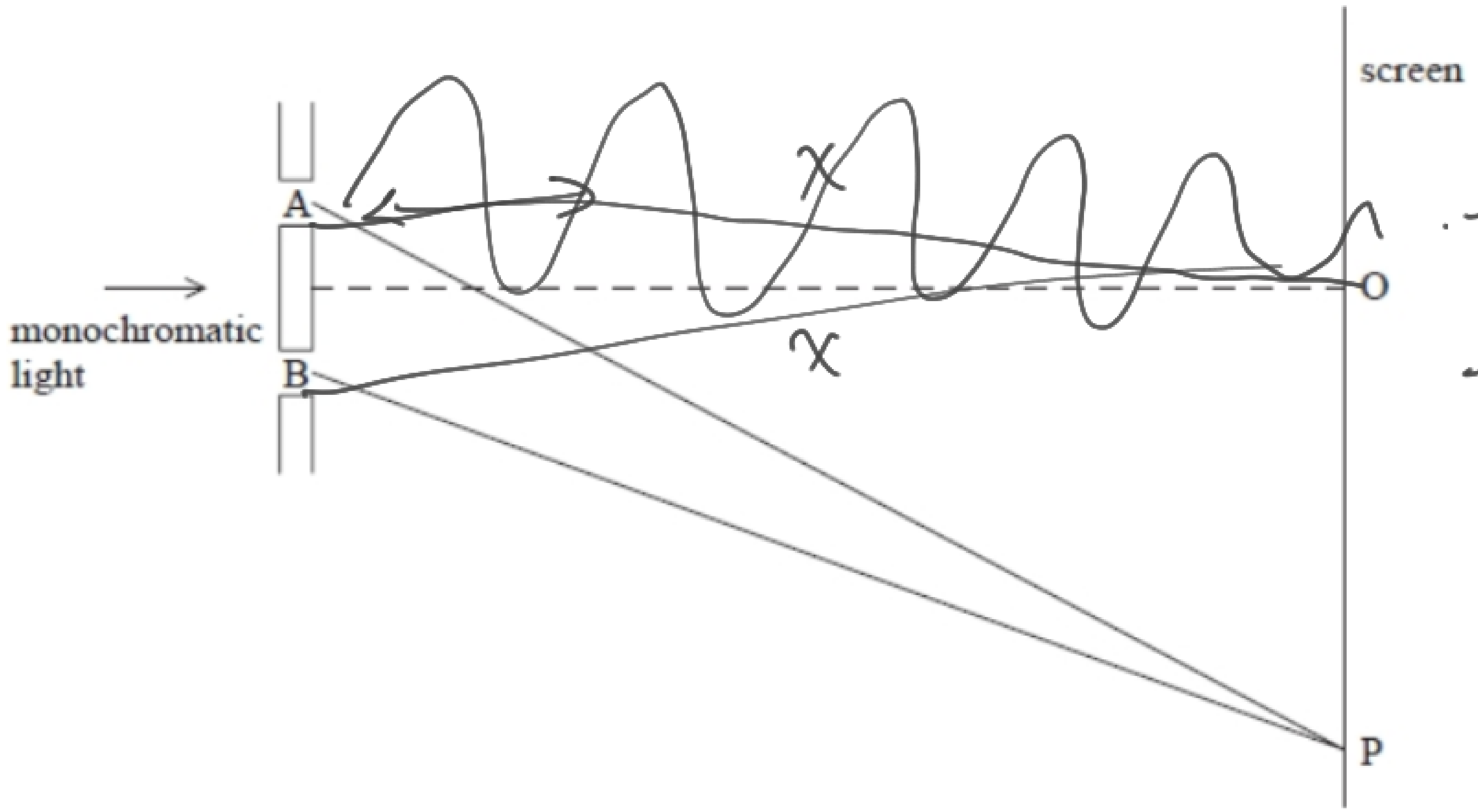
λ_2:

$d \sin\theta_2 = m\lambda_2$

(Total for question = 4 marks)

Q11.

The experiment was carried out with laser light of wavelength 600 nm. The diagram below shows two paths taken by the light after it has passed through the two slits A and B. The diagram is not to scale.



$\frac{x}{\lambda}$

$\frac{x}{\lambda}$

(i) • Path difference at O

$= 0 = 0\lambda$

• wave arrive in / out of phase

↓ ↓

A↑ A→

Arrive in phase

$\Delta = m\lambda$

m is $\mathbb{Z}$

Out of phase

$\Delta = (m + 0.5)\lambda$

$m \in \mathbb{Z}$

(i) Point O is a point equidistant from the two slits.
Explain why there is a bright line at this point.

(3)

• Superposition occurs, two waves reinforce each other → constructive interference occurs → Bright line

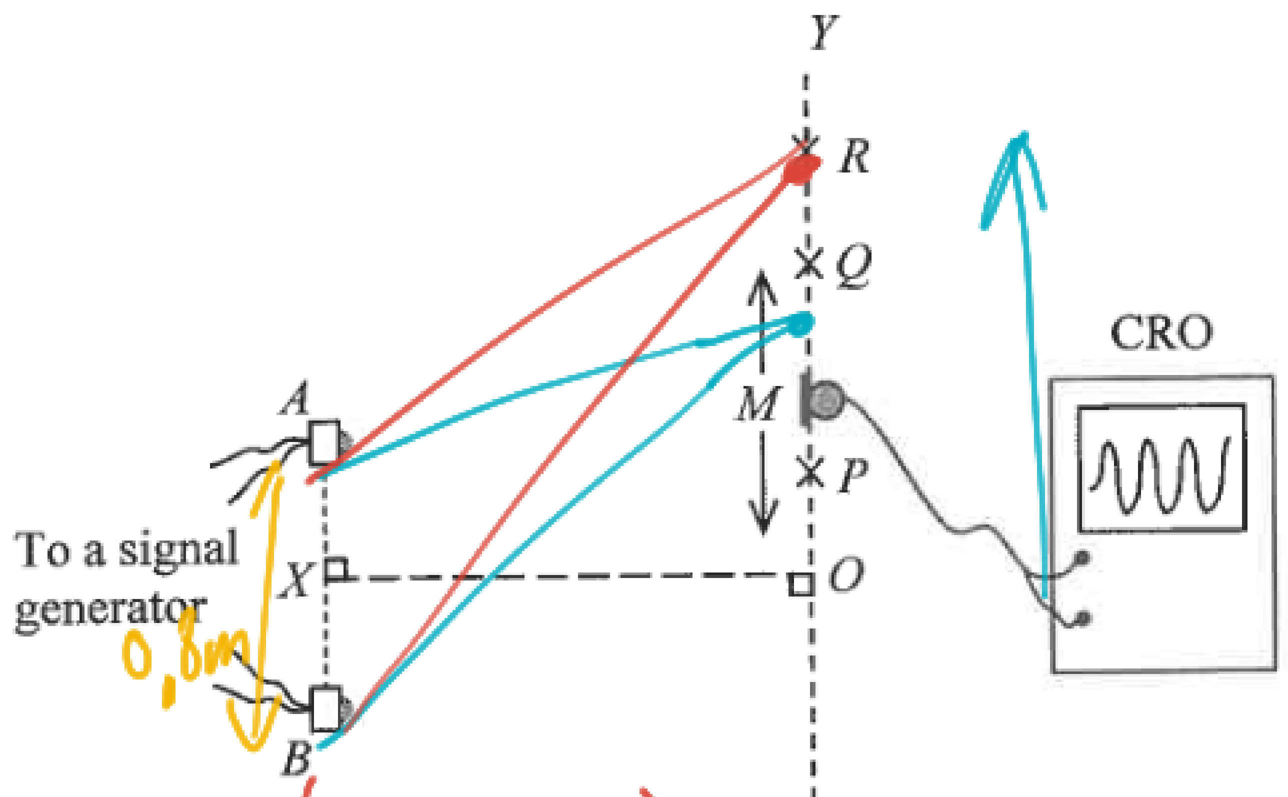
....

(ii) The next bright line is observed on the screen at point P. Lines AP and BP show the path of the light from each slit to the screen at P.
State the difference in the lengths of the paths AP and BP.

(1)

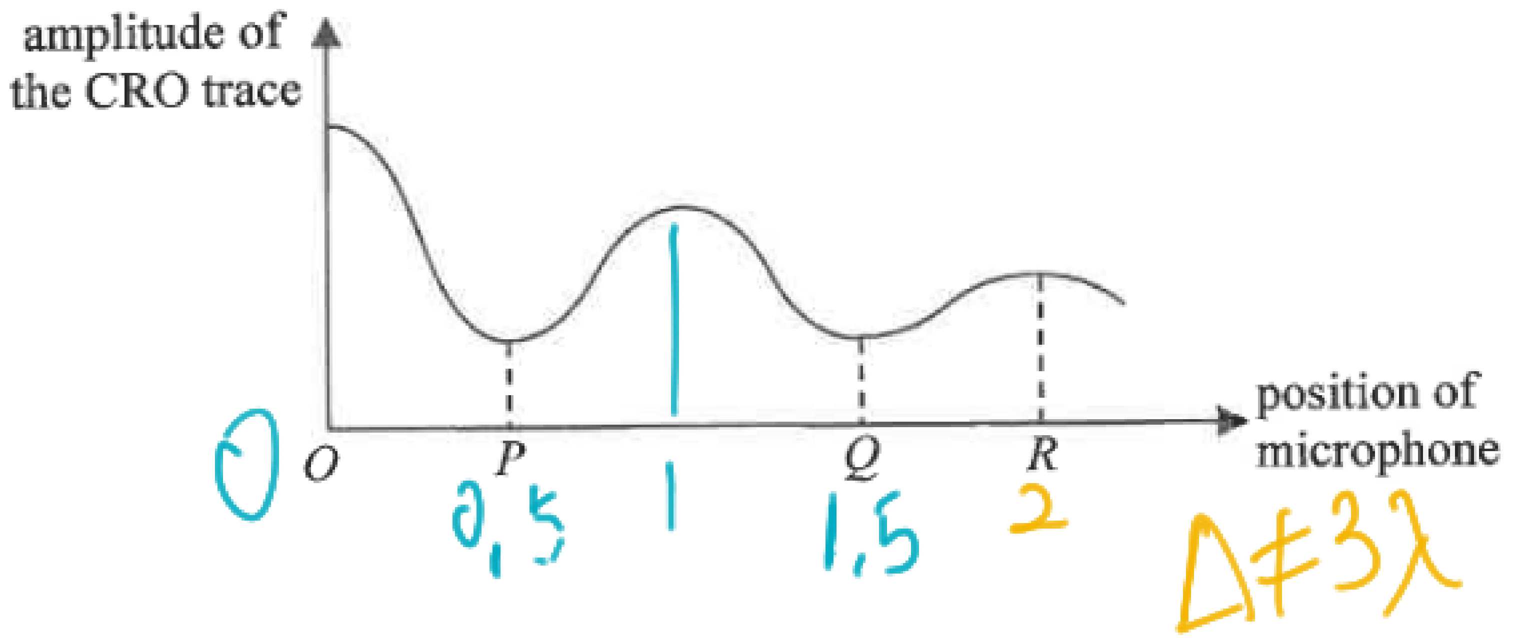
Difference in lengths of paths = ...

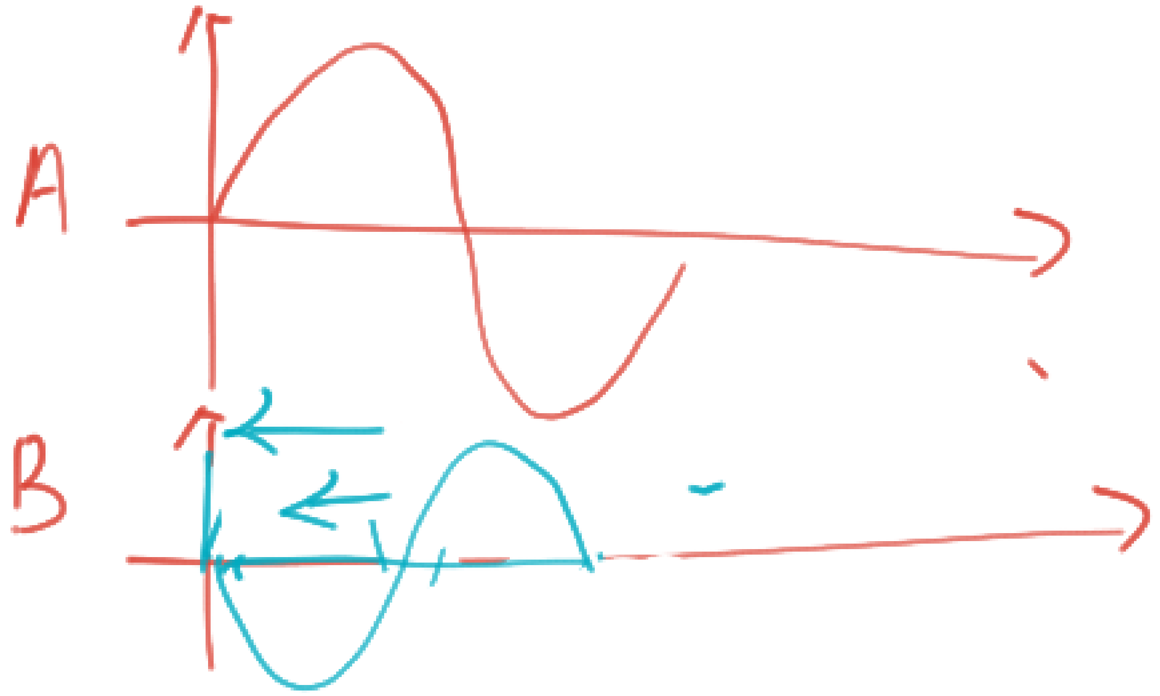
(Total for question = 4 marks)



$\Delta_1 = (QA - QB)$ $\Delta_2 = (RA - RB)$

re 6.1, two small identical loudspeakers A and B produce coherent sound waves. X is the mid-poi
A microphone M connected to a CRO is moved along OY to detect the loudness of the sound, with CR
a larger amplitude representing a greater loudness. Figure 6.2 shows the result.





(a) Explain what is meant by **coherent** sound waves. (1 mark)

Same f

(b) (i) Explain why sound of alternate maximum and minimum loudness is detected along OY. (2 marks)

$\Delta = m\lambda \rightarrow$ con (Max)

$\Delta = (m + 0,5)\lambda \rightarrow$ Des (Min)

Walking $\rightarrow \Delta$ will increase

At $\Delta = (m + 0,5)\lambda \rightarrow$ Destructive $\rightarrow$ Min

At $\Delta = m\lambda \rightarrow$ Constructive $\rightarrow$ Max

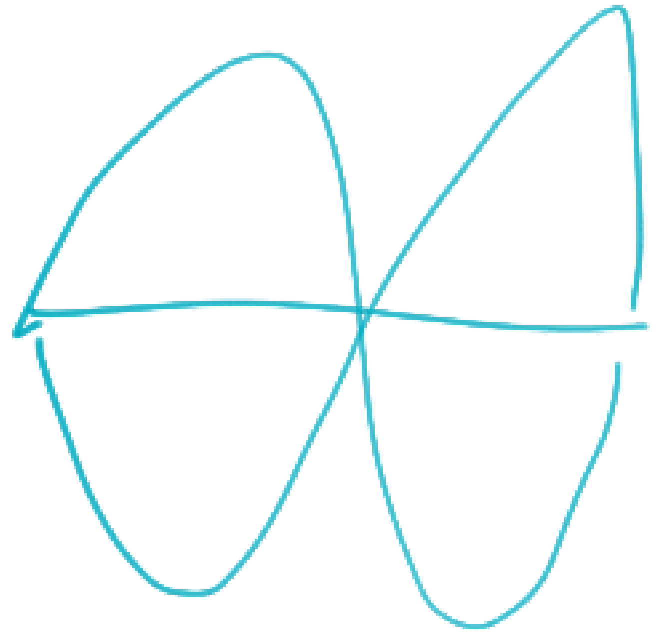
Δ alternates between $(m+0,5)\lambda$ & $m\lambda$

Answers written in the margins will not be marked.

alternating occurences of

(ii) The amplitude of the CRO trace at P is **not** zero. Suggest a possible reason. (1 mark)

Background sound reflects off the walls of the lab and are collected by the microphone

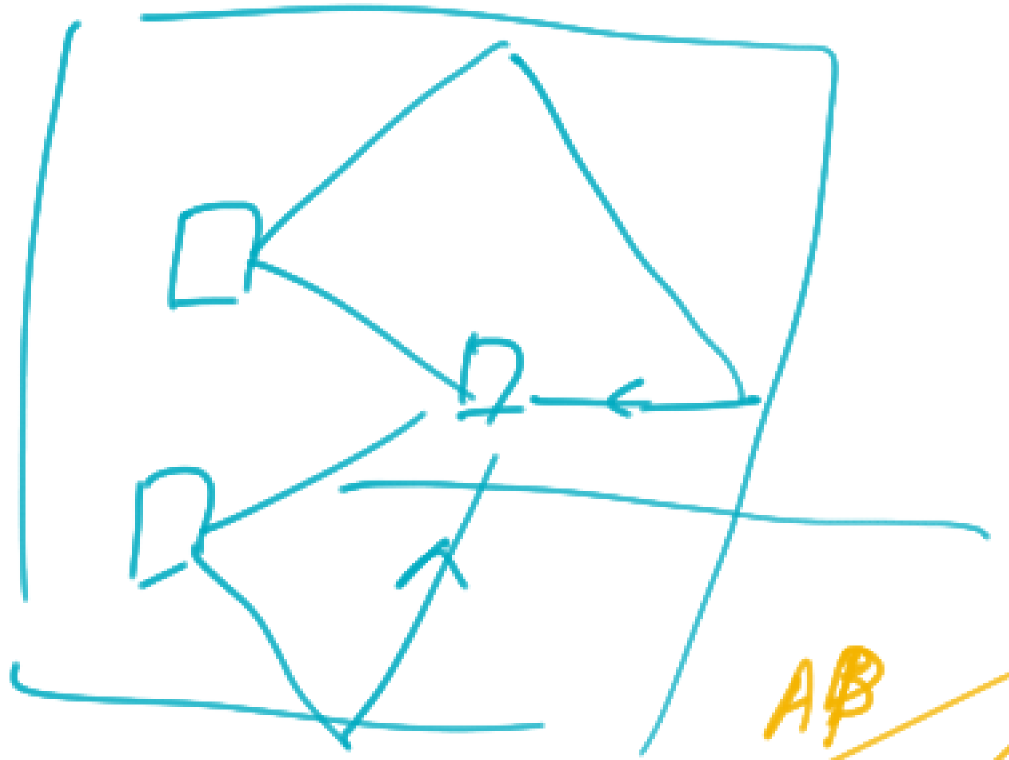


(c) Given: $AQ = 2.17$ m, $BQ = 2.58$ m
Find the speed of sound in air if the frequency of the signal generator is 1200 Hz. (2 marks)

$BQ - AQ = \Delta q = 1.5\lambda$

$v = f\lambda$

$v = \cancel{340}\ ms^{-1}$
328



(d) Given that the separation of A and B is 0.80 m, explain why no more maximum can be detected when the microphone is moved beyond position R along OY. (2 marks)

$3\lambda = 0.82m$ $\quad \Delta < 0.82$

Δ will never reach 3λ → No more maximum beyond R

$AP + 0.8 > BP$
$BP - AP < 0.8$
$\Delta < 0.8$

(e) The microphone is now moved from O to X along the line OX. State whether the amplitude of the CRO trace increases, decreases, remains the same, or varies periodically. (1 mark)

increases