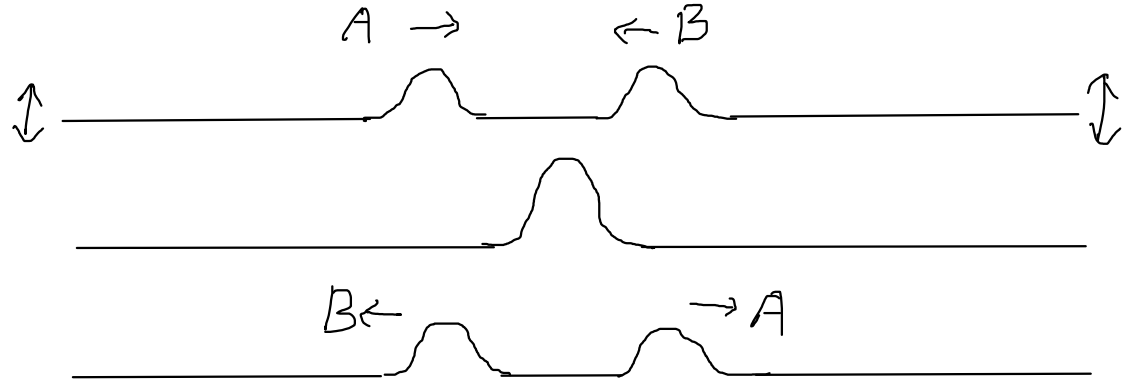
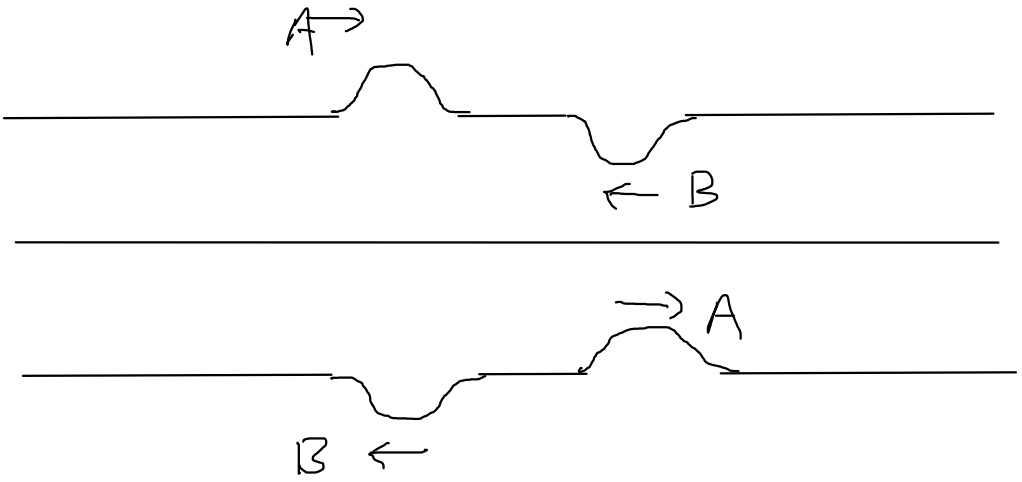
Superposition

Dr K M Hock

Add



Cancel



Two waves can add (like numbers for two graphs).

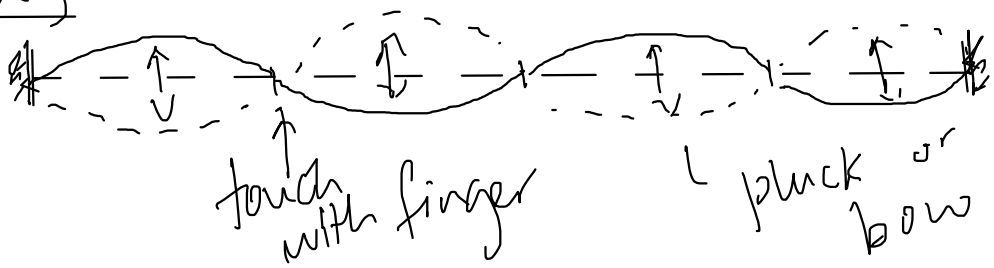
Displacements in opposite directions add like numbers with opposite signs - they cancel.

show an understanding of experiments which demonstrate stationary waves using microwaves, stretched strings and air columns

Stationary Waves

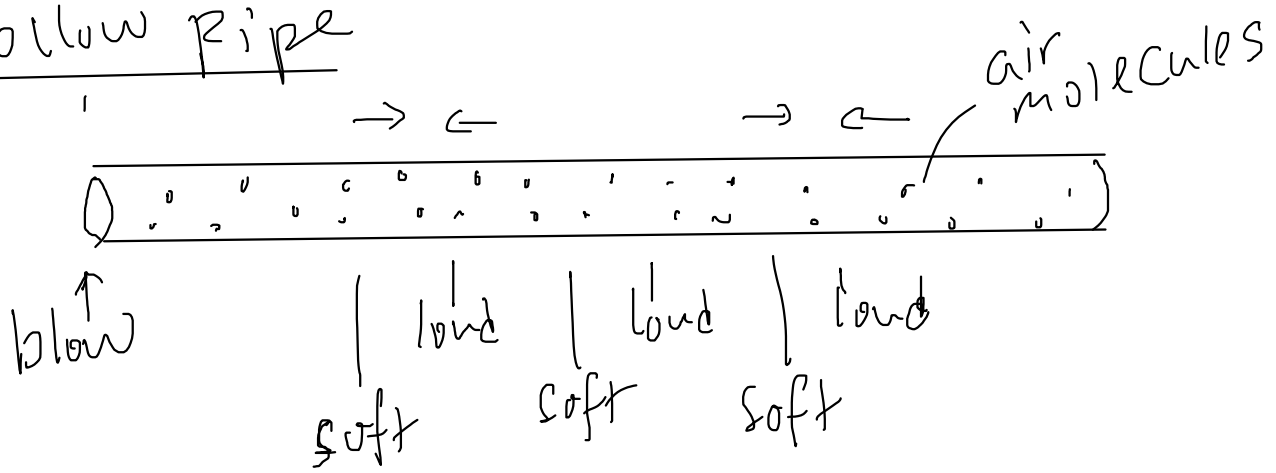
Dr K M Hock

String



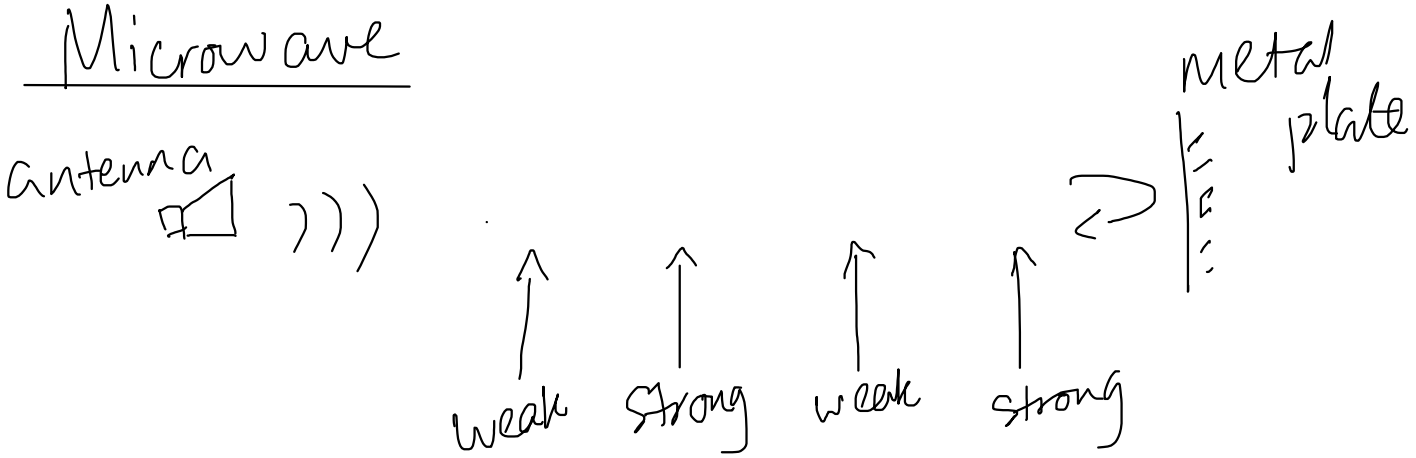
- Can create this on violin or guitar (if you are good).

Hollow Pipe



- Can create on a flute for high pitch.

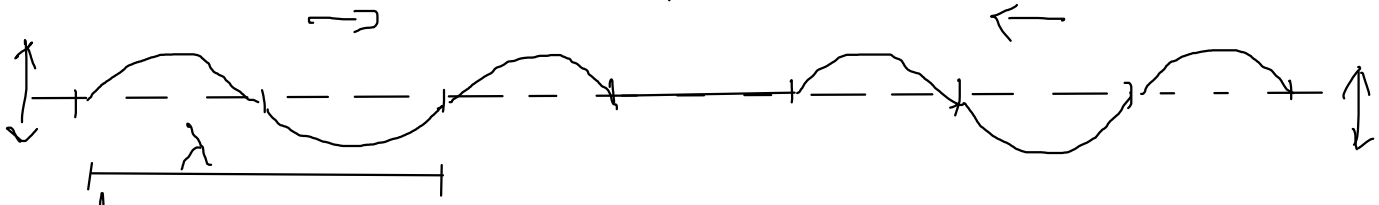
Microwave



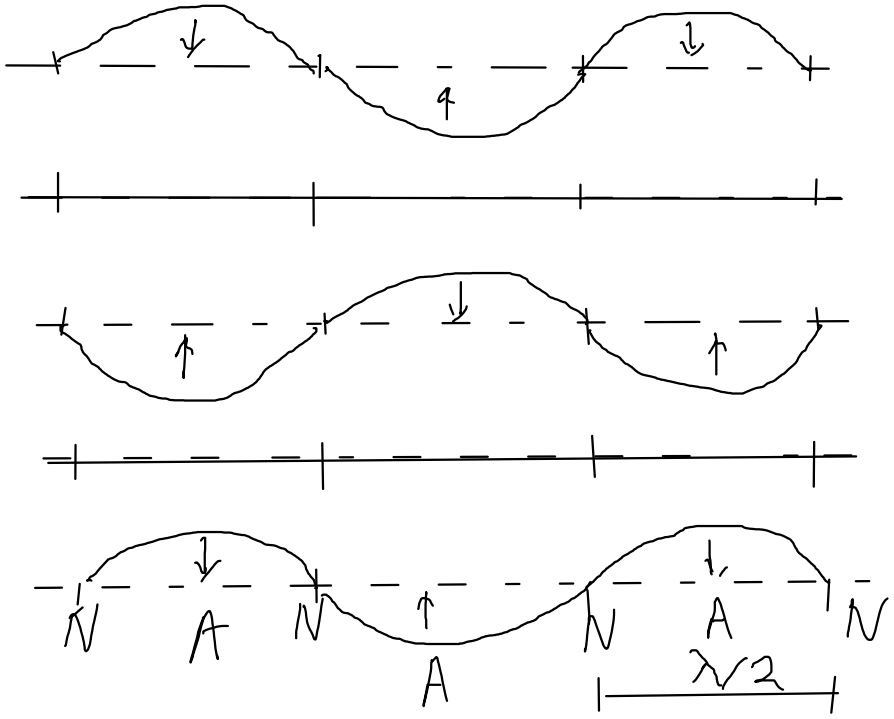
Stationary Waves 2

Dr K M Hock

Imagine :- 2 identical waves in opposite directions ...



When they meet : Superposition



At N - always zero displacement

↓

Nodes

At A - always max. displacement

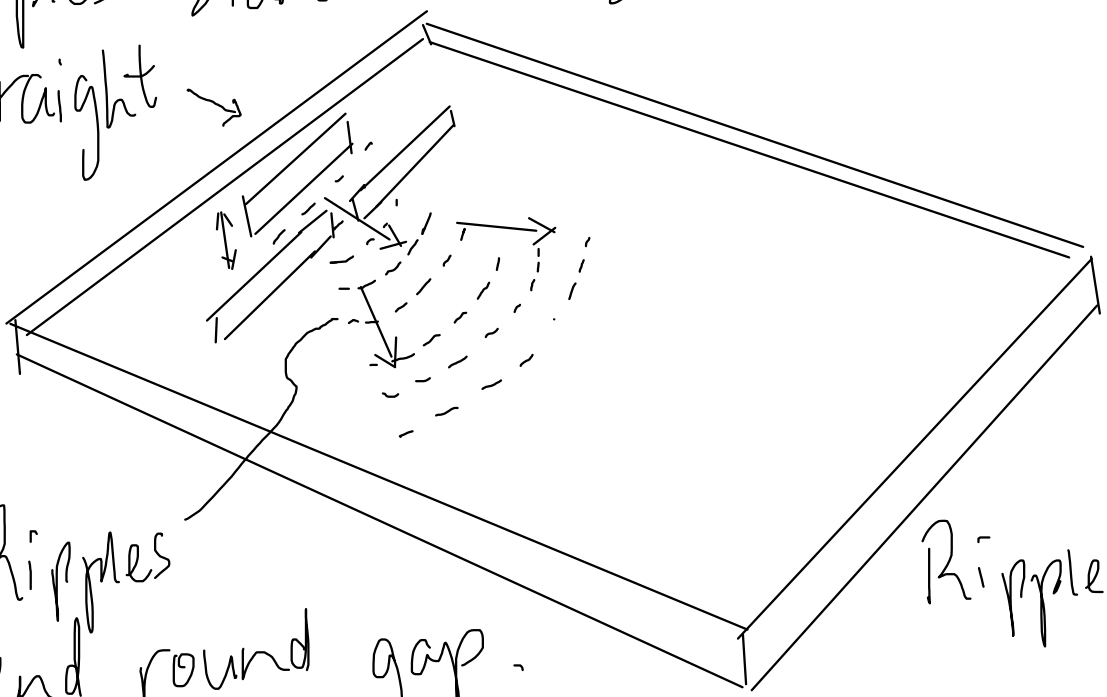
↑

Antinode

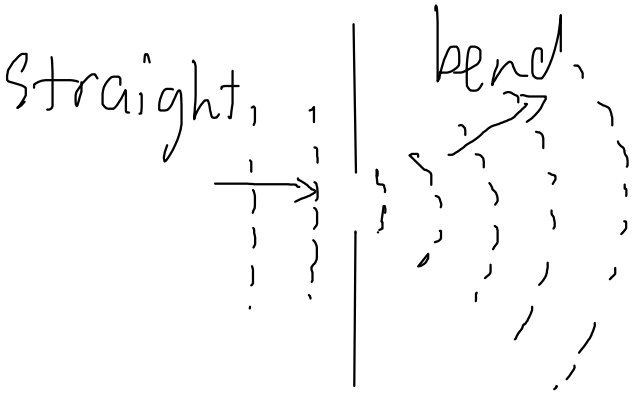
explain the meaning of the term diffraction
show an understanding of experiments which demonstrate diffraction including the diffraction of wate
waves in a ripple tank with both a wide gap and a narrow gap

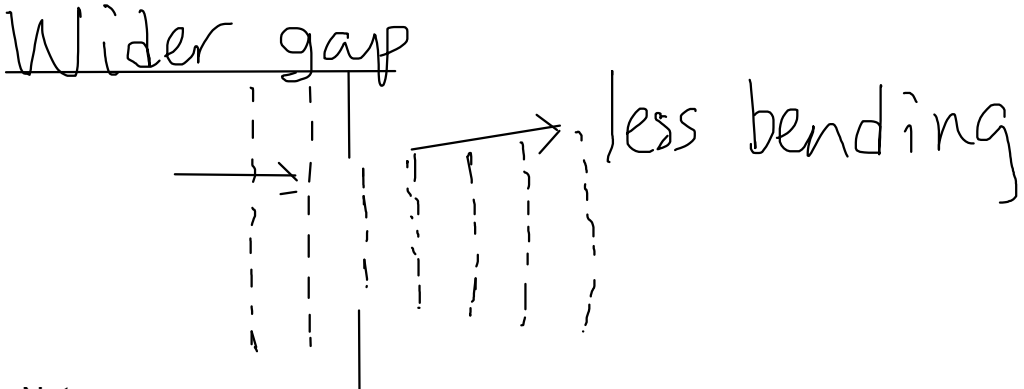
Diffraction

Dr K M Hock



Diffraction - wave bending round corner.

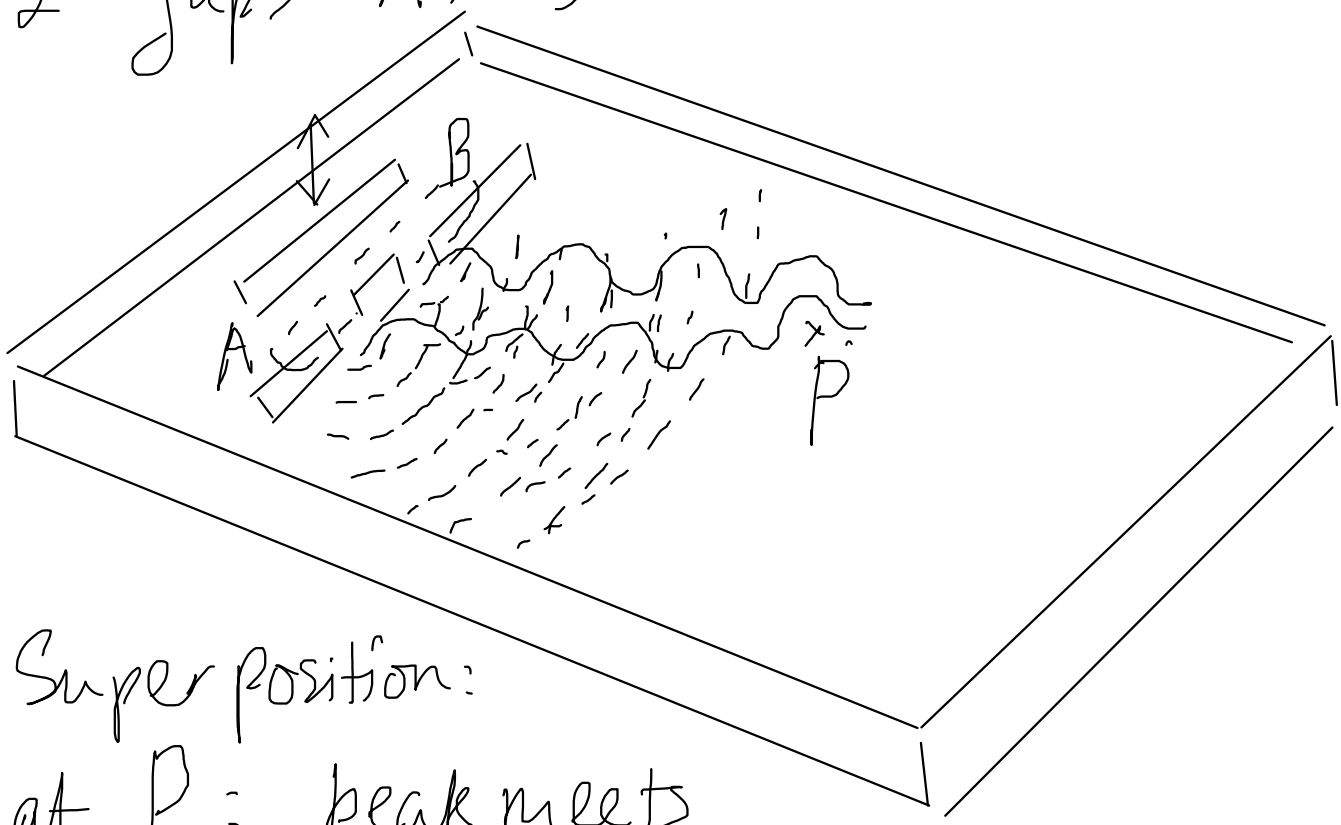




Interference

Dr K M Hock

2 gaps A, B



Superposition:

at P: peak meets peak → bigger peak

Happens if

AP − BP = whole no. of wavelength

path difference = $n\lambda$

↓

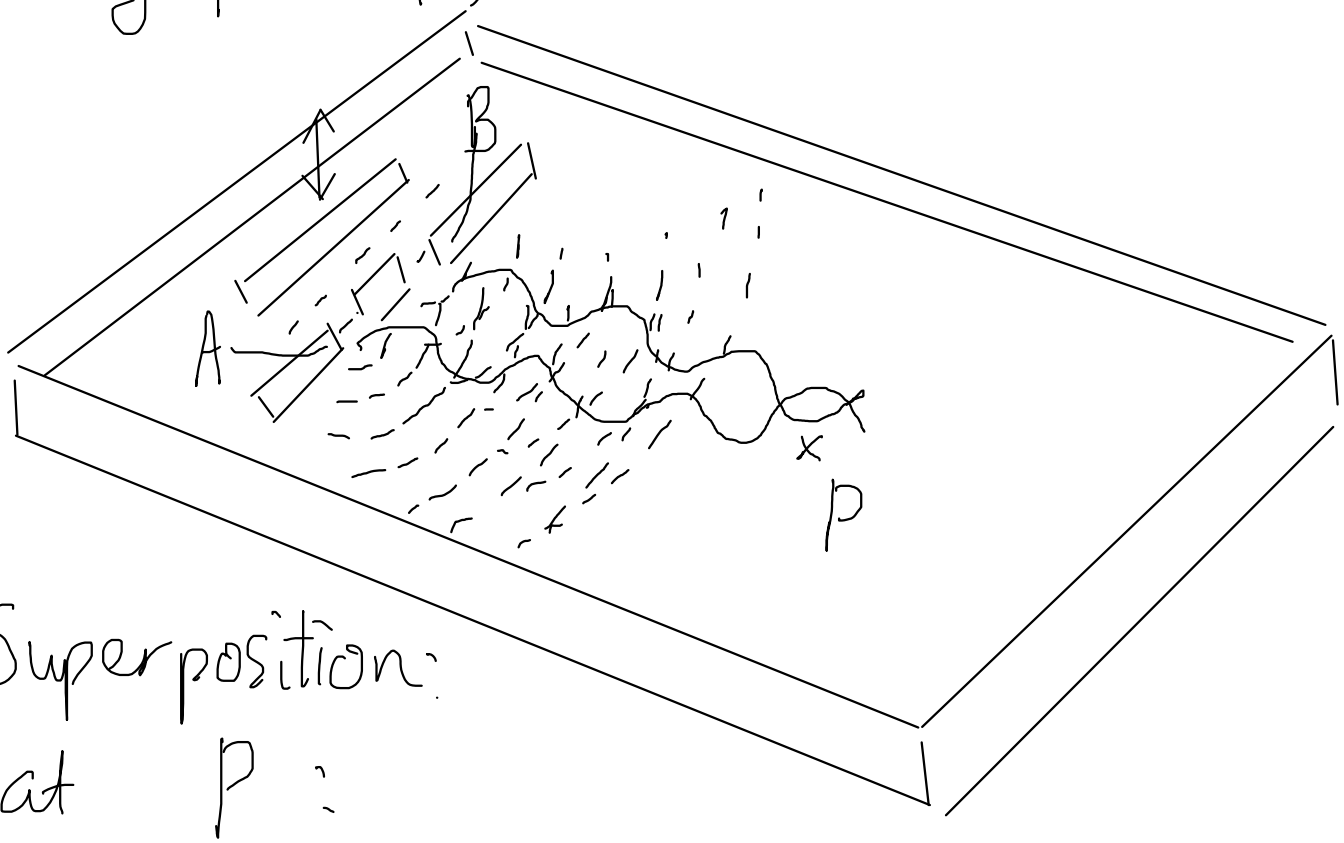
Constructive Interference

show an understanding of experiments which demonstrate two-source interference using water, light and microwaves

Interference 2

Dr K M Hock

2 gaps A, B



Superposition at P:

Peak meets trough → cancels

Happens if

AP − BP = whole no. + ½ wavelength

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

↓

destructive interference

show an understanding of experiments which demonstrate two-source interference using water, light and microwaves

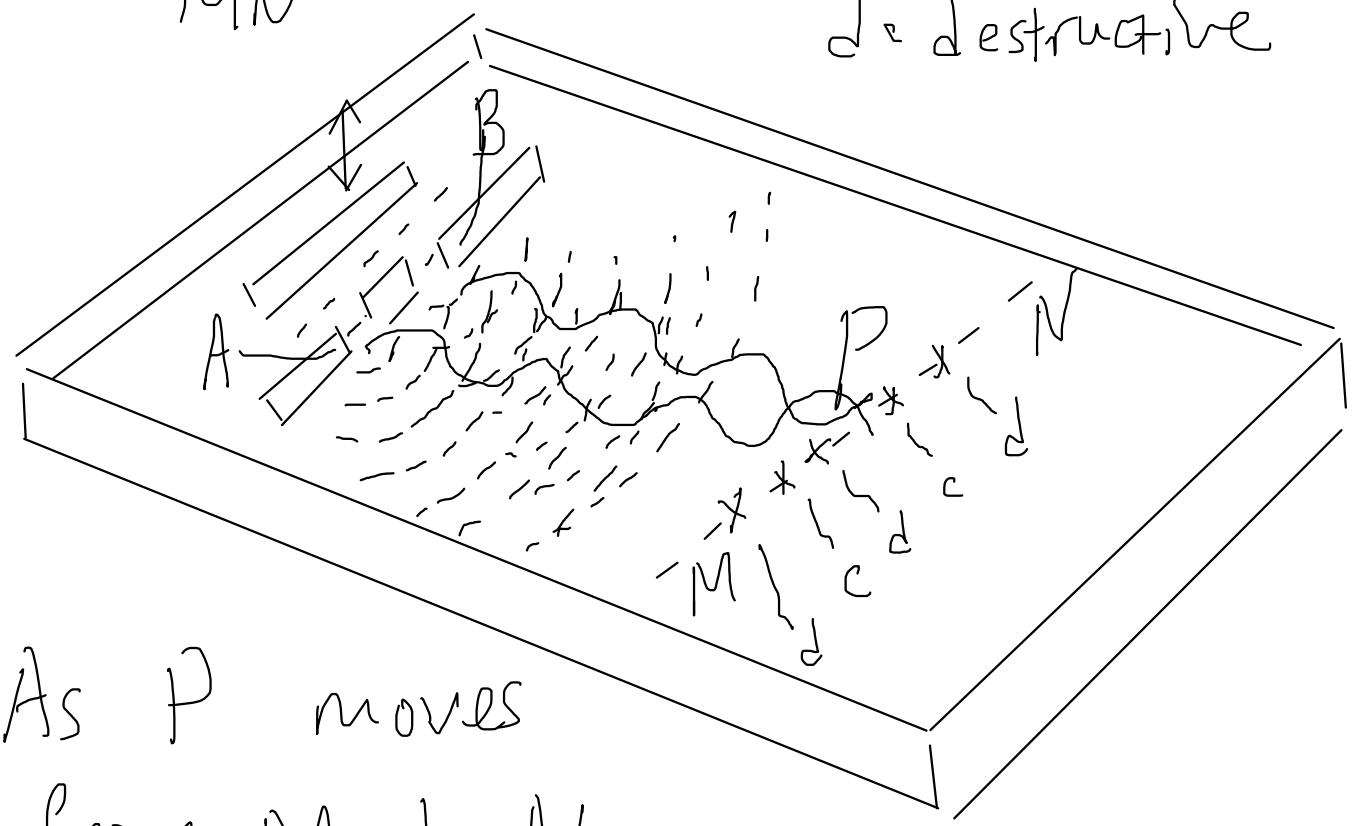
Interference Fringes

Dr K M Hock

P - point on MN

c : constructive

d : destructive



As P moves from M to N,

path difference AP - BP ↑

... $-\frac{1}{2}\lambda$, 0, $\frac{1}{2}\lambda$, λ, $1\frac{1}{2}\lambda$, 2λ, ...

d c d c d c

We see :

wave, no wave, wave, no wave, ...

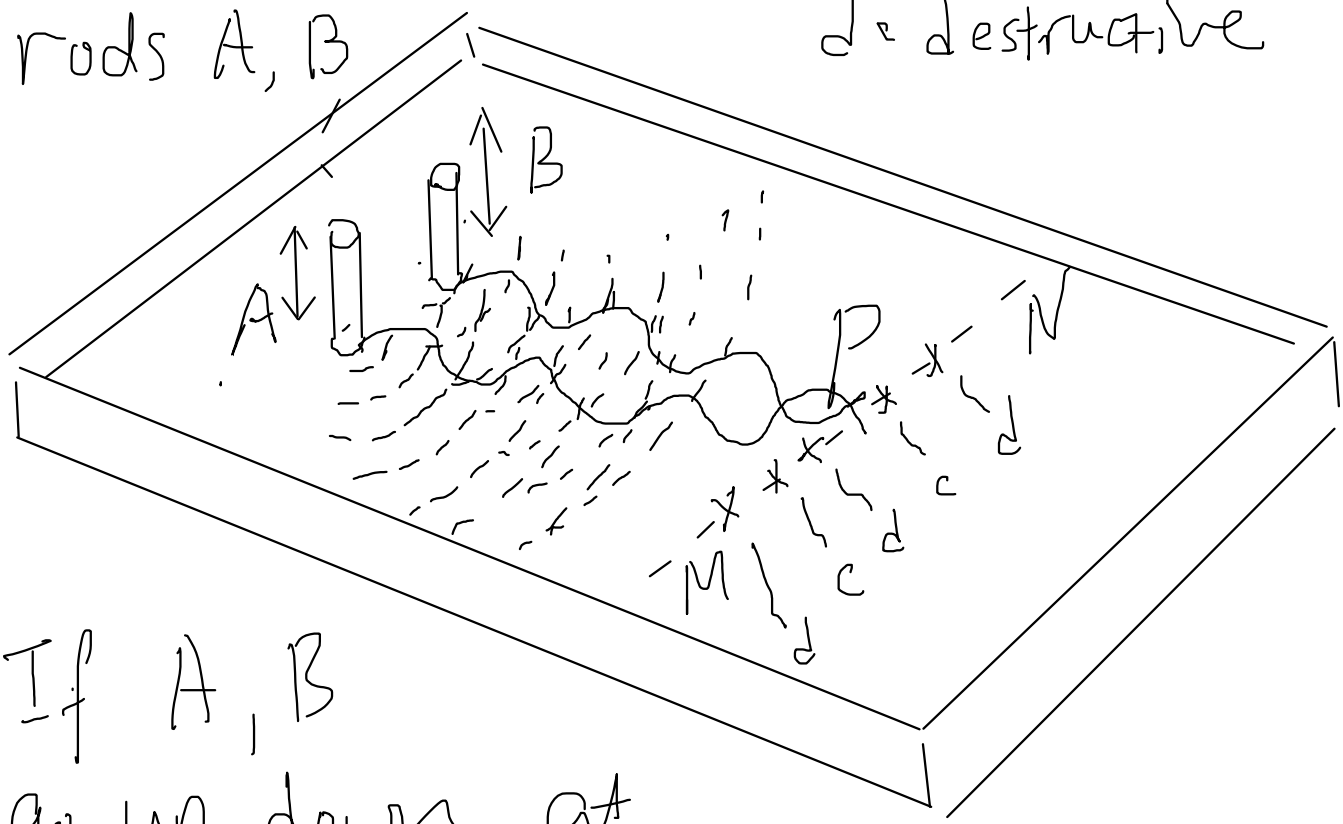
interference fringes

Coherence

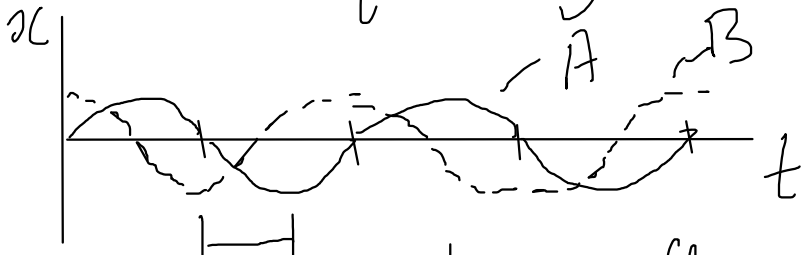
Dr K M Hock

Replace gaps by rods A, B

c : constructive
d : destructive



If A, B go up, down at same frequency & similar amplitudes,



Constant phase diff.

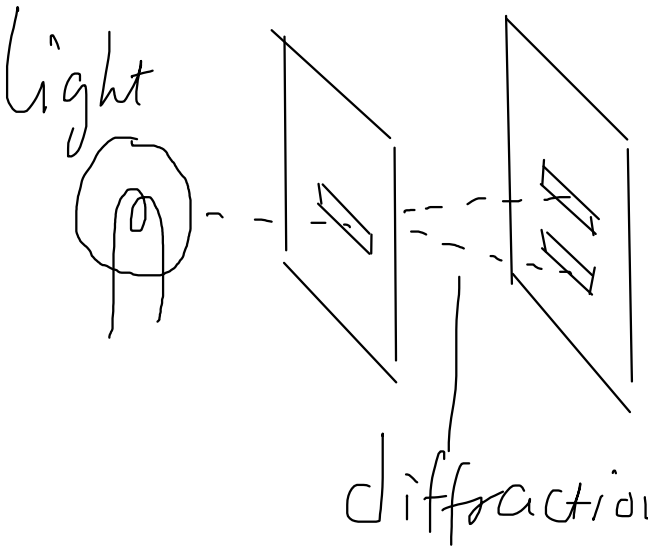
COHERENT

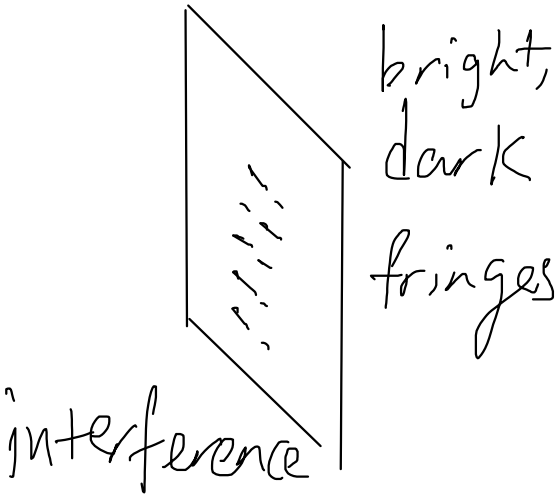
Can still get fringes even if up, down not together.

If A, B move randomly, then fringes messed up.

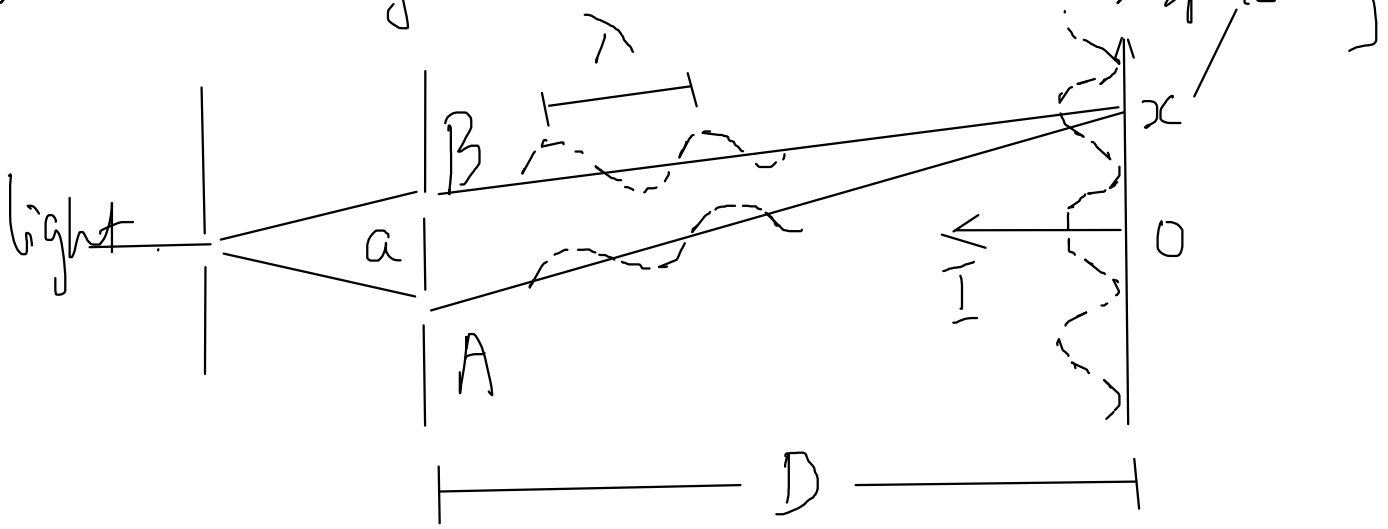
Double-slit Interference

Dr K M Hock





Schematically:



Formula

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

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e.g. $a = 1\text{ mm}$, $x = 0.6\text{ mm}$, $D = 1\text{ m}$

Find wavelength of the light.

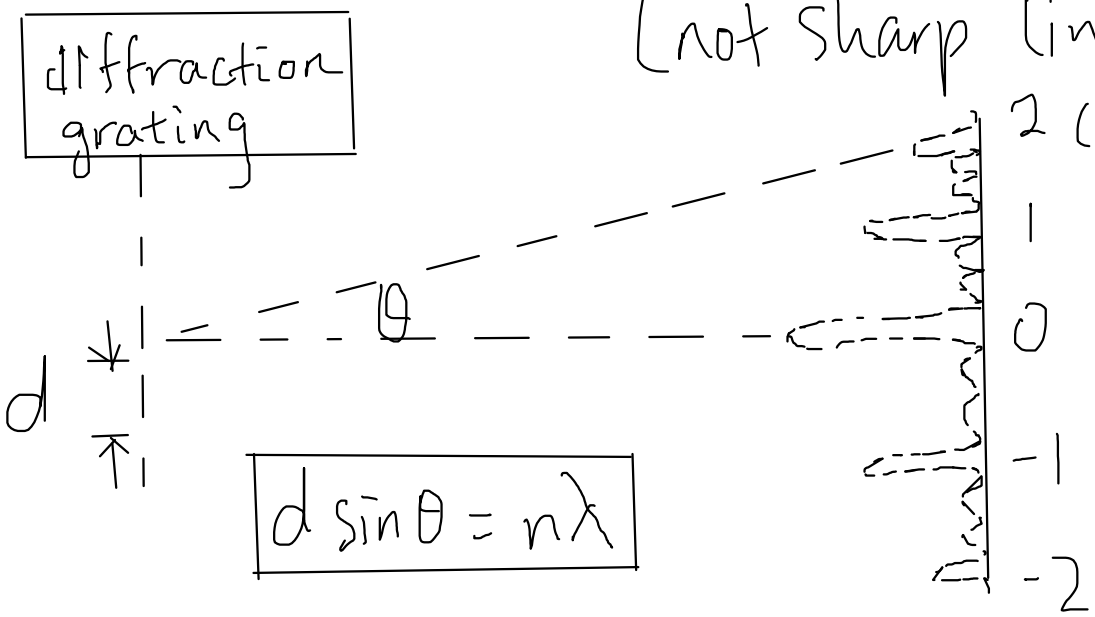
$$\lambda = \frac{0.001 \times 0.0006}{1} = 600\text{ nm}$$

recall and solve problems by using the formula d sin θ = n λ and describe the use of a diffraction grating to determine the wavelength of light.

Diffraction Grating

Dr K M Hock

Double slit useful to measure λ,
but not accurate: fringes broad
(not sharp lines).



Using more slits gives narrow fringes → sharp lines, further apart, measure more accurately.

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e.g. grating has 300 lines/mm.
Angle is 10.37° for first fringe.
Find wavelength.

$$\lambda = \frac{d \sin\theta}{n} = \frac{10^{-3}}{300} \times \frac{\sin 10.37^\circ}{1} = 600 \text{ nm}$$