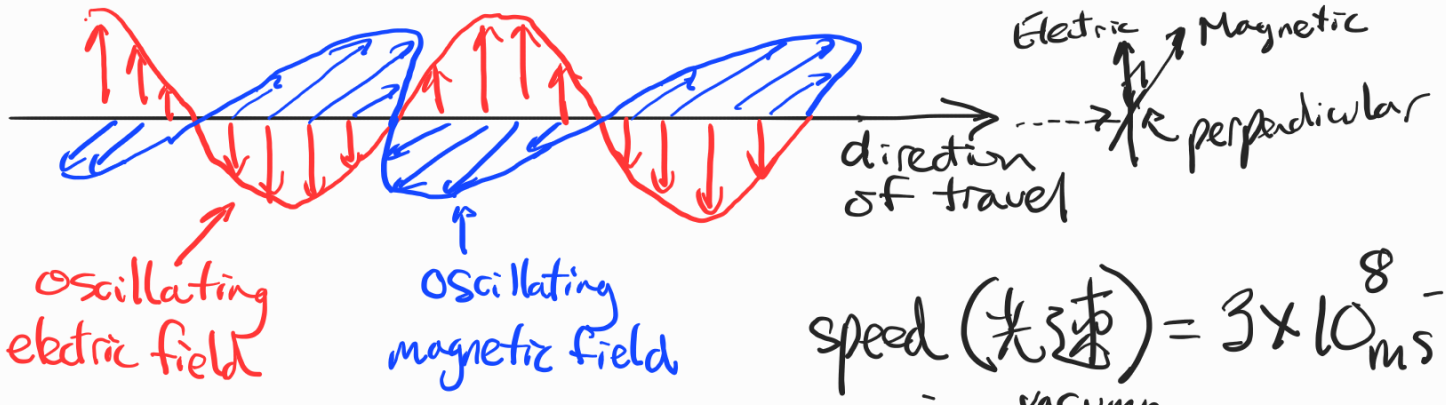
3.4 Light and Sound

LIGHT

Visible light belongs to Electromagnetic waves (EM waves)
電磁波

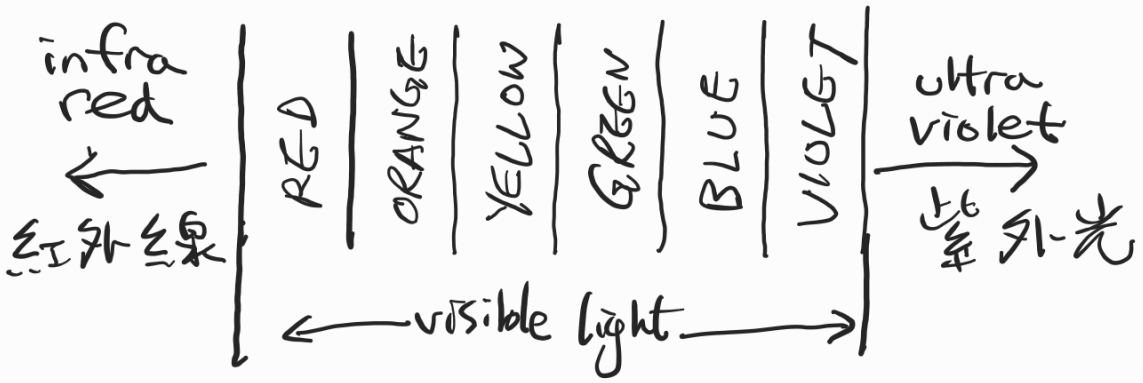


speed (光速) in vacumn $= 3 \times 10^{8}\ ms^{-1}$

EM wave can travel in SPACE (in vacumn)
太空

Wide frequency spectrum
頻率 波譜

Visible Light Spectrum



780 nm ---------- 390 nm ← WAVELENGTH

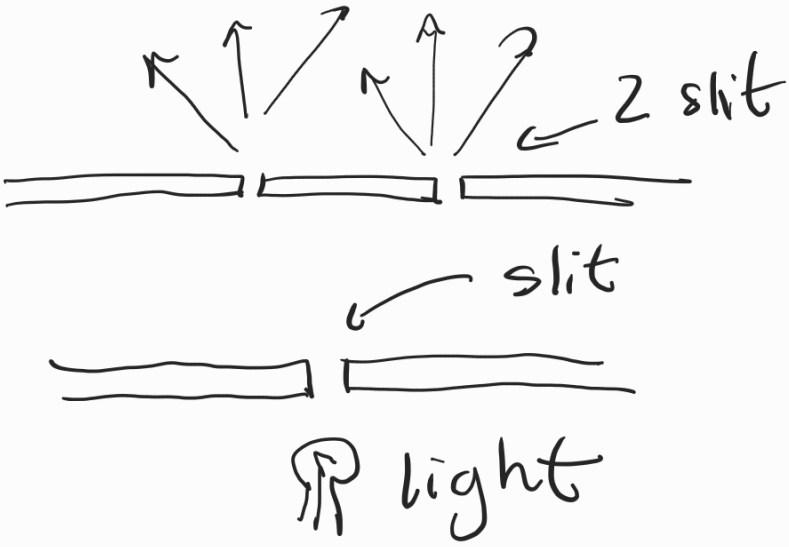
$(780 \times 10^{-9}\ m)$

frequency × wavelength $= 3 \times 10^{8}\ ms^{-1}$ (speed)

Youngs double slit experiment

(to observe interference in light)

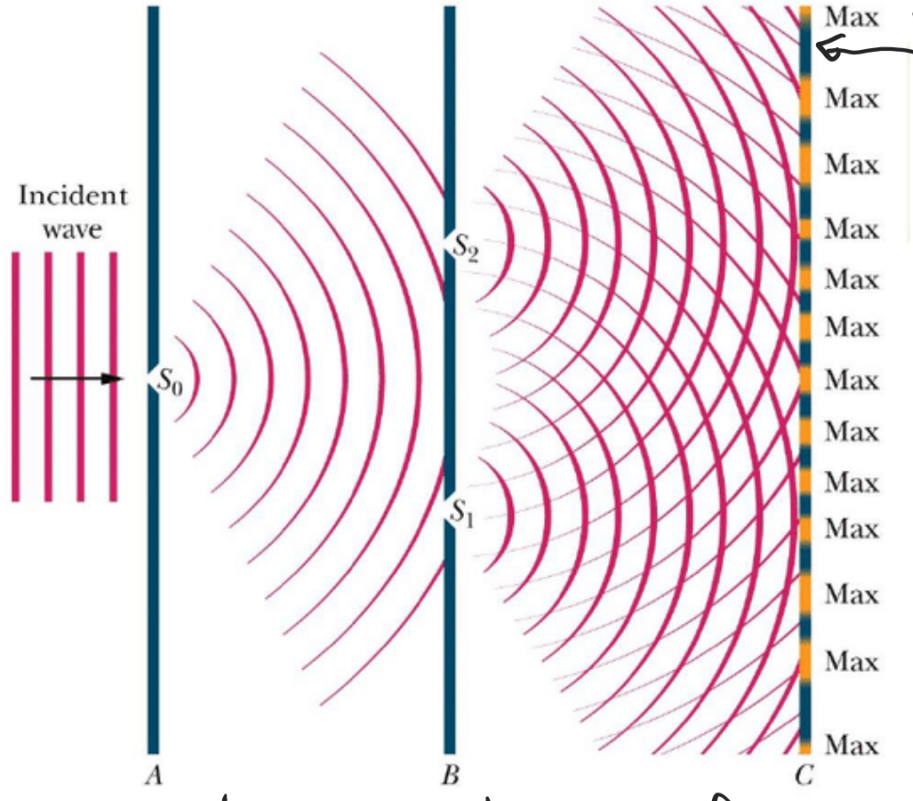
SCREEN



constructive interference

destructive interference

6. The figure shows an outline of Young's double slit experiment. Describe your thoughts and reasons for the areas where the dark patterns appear in terms of energy.



fringe seperation Δy

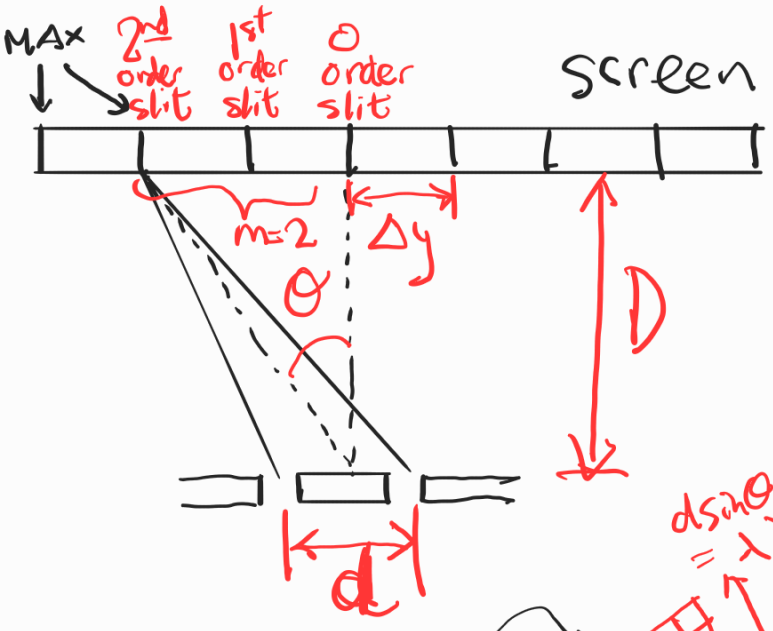
Fringe seperation is larger, if
* wave length is longer
* split separation is smaller

Fringe separation (Δy)

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

for $m = 1$

for $D \gg d$ (θ is small)

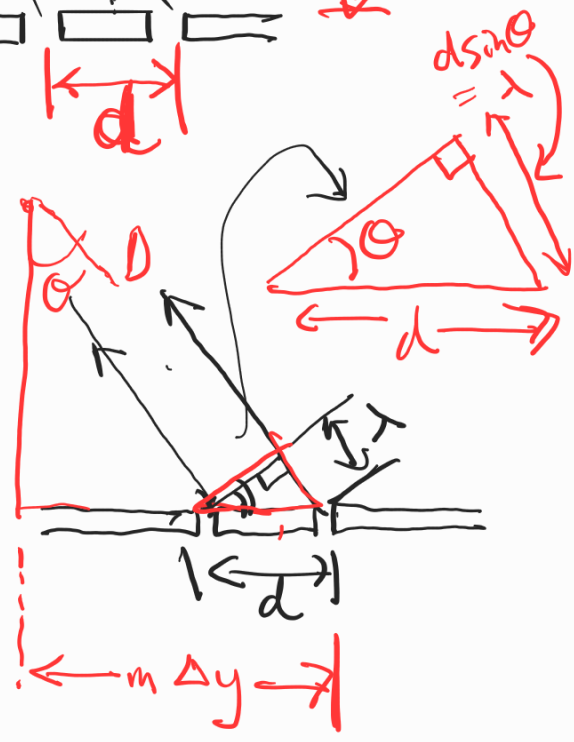


λ : wavelength

D : slit screen separation

d : slit separation (縫)

m : no of slit separation from centre



$$\sin\theta = \frac{\lambda}{d} \approx \tan\theta = \frac{m\Delta y}{D}$$

$$\frac{\lambda}{d} \approx \frac{m\Delta y}{D} \quad (m=1)$$

EM SPECTRUM

Low Frequency ↓ — High Frequency ↓

Radio Waves	Micro Waves	Infrared Radiation (IR)	Visible Light	Ultraviolet Radiation (UV)	X-rays	Gamma Rays
Wireless devices	cooking	Heating remote control	we can see	Sterilizing 消毒	medical image	Radio therapy 電療

SOUND

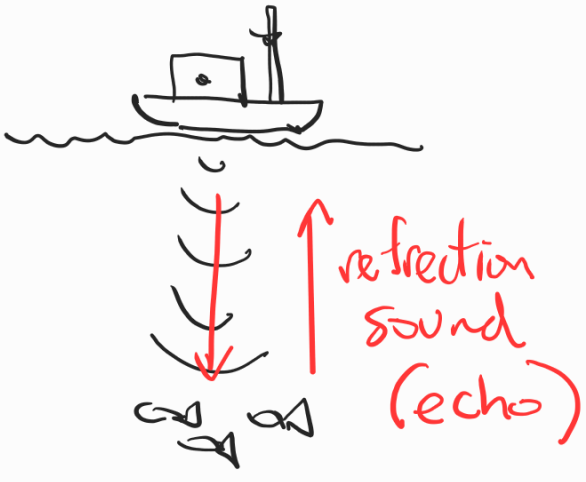
Another kind of wave in our daily life

* mechanical waves, vibration
* cannot travel in vacuum
* travels fastest in solids, slower in liquid, slowest in gas

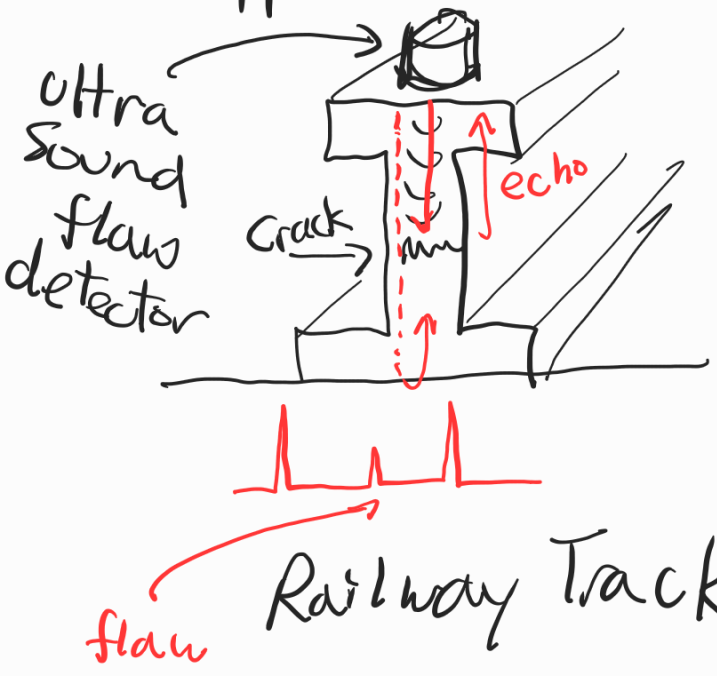
(example) $6420\ ms^{-1}$ metal $1497\ ms^{-1}$ water $343\ ms^{-1}$ air

* In air, it is a longitudinal wave
* Human listening range 20 – 20kHz
* Ultrasound (超聲波) is > 20kHz

Sonar (聲納) an application of sound



fishing



Railway Track

Musical Notes and Noise

音樂　　噪音

Pitch: subjective (主觀) quantity for describing musical notes.

Loudness: subjective quantity for describing how loud sound is

Quanlity: subjective quantity for describing musical notes

Sound intensity: describing loudness (in dB)
decibel

0 dB : can just hear
85 dB : busy street
150 dB : explosion

For every +10dB, sound level doubles (×2)

e.g 0 dB → 150 dB is equal to $\times 2^{15}$

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