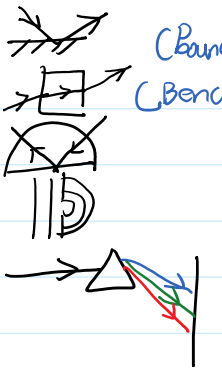
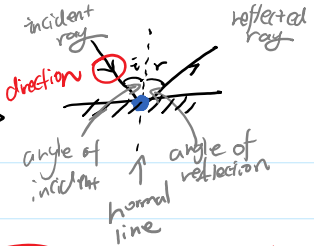
2/5

Monday, February 5, 2018 1:51 PM

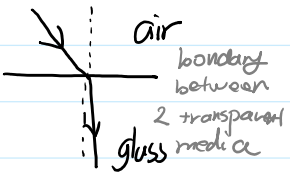
properties of waves { reflection, refraction, TIR, diffraction, dispersion



(Bouncing off)



(Bending)



scattering → going everywhere.

• allows us to see

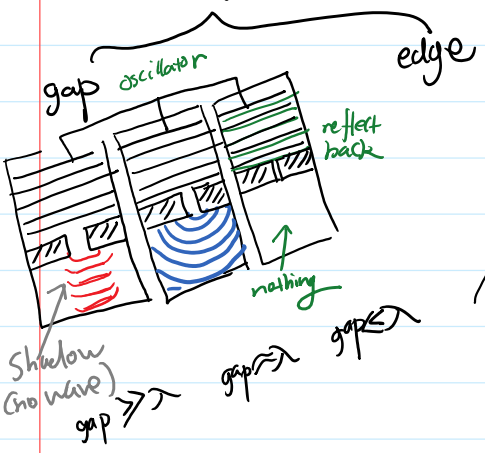
nothing happened when goes on the normal

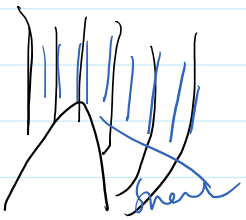
speed changes in different medium

f maintains

↓↑ and ↑↓

(spreading)





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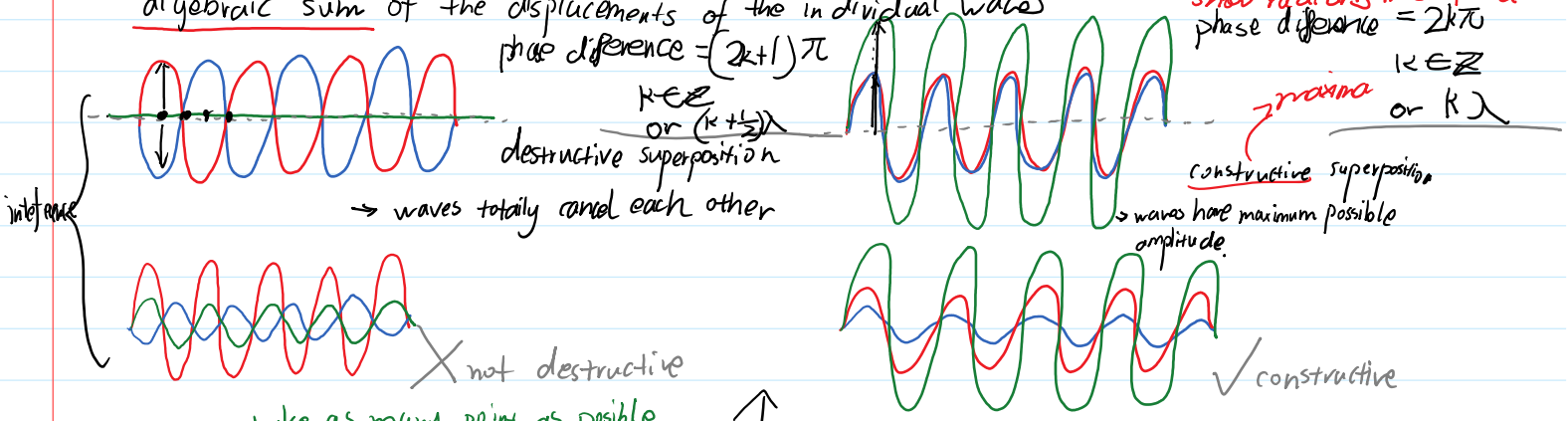
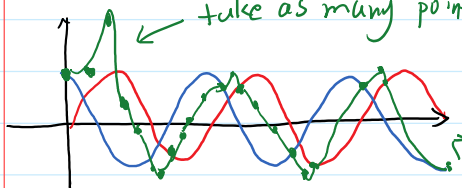
Wednesday, February 7, 2018 3:31 AM

Superposition

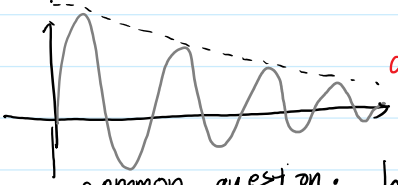
- principle of superposition: added up
  when two or more waves meet at the point the resultant displacement is the algebraic sum of the displacements of the individual waves



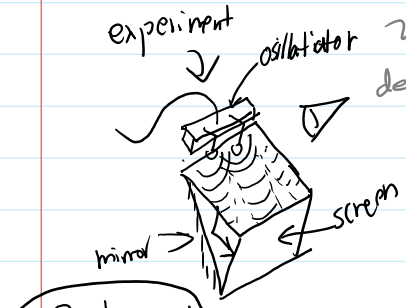


Interference: is when results superposition patterned

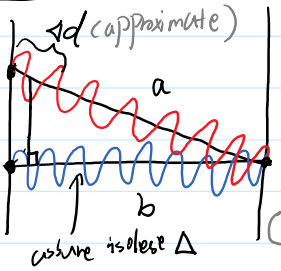
superposition: resultant wave change in time,
take as many point as possible to have maximum accuracy



common question: how to demonstrate it?



Path difference Δd → allows to predict result of superposition



$k\lambda \Rightarrow k\in\mathbb{N}$ ← $2k\pi$ ← constructive? destructive? → $(2k+1)\pi$ ← $k\lambda \Rightarrow (2k+1)\frac{\lambda}{2} \Rightarrow k\in\mathbb{N}$

① $\Delta d = |a-b|$ { con. $\Delta d = k\lambda$ $k\in\mathbb{N}$; des: $\Delta d = (2k+1)\frac{\lambda}{2} = (k+\frac{1}{2})\lambda$

② not to scale: draw the ray, put perpendicular distance

to scale / labelled with number

when $k=0 \Rightarrow \Delta d = k\lambda = 0 \Rightarrow$ zeroth maxima

1 ⇒ 1 ⇒ first maxima

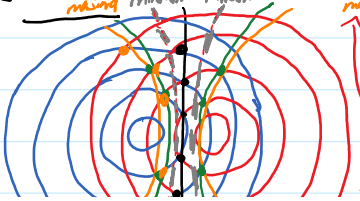
2 ⇒ 2 ⇒ second maxima

$k \Rightarrow$ number of maxima

superposition (count the No. of Crest).

minima draw accurate in between

you need to do solid line here →

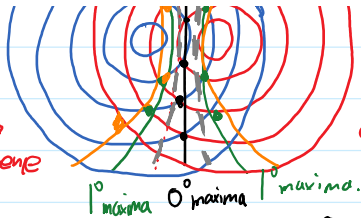


Coherent sources

- constant phase difference
- constant f

} to make a stable interference

do solid line here →



this is interference

we count maxima only

- constant phase difference
- constant f

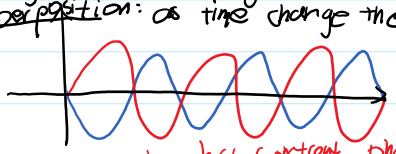
} to make pattern interference

- constant λ and A

picture of superposition does not change

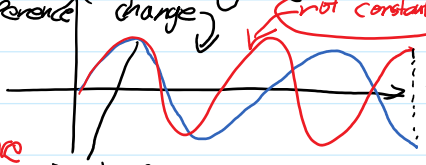
interference: as time go the maxima & minima don't change (because of identical source)

Superposition: as time change the path difference change



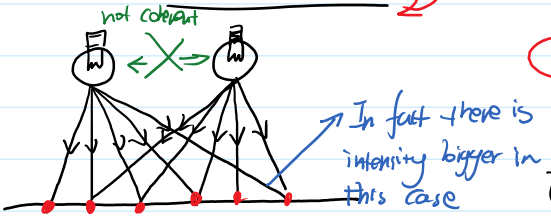
Source that has constant phase difference

coherent



in phase

non coherent



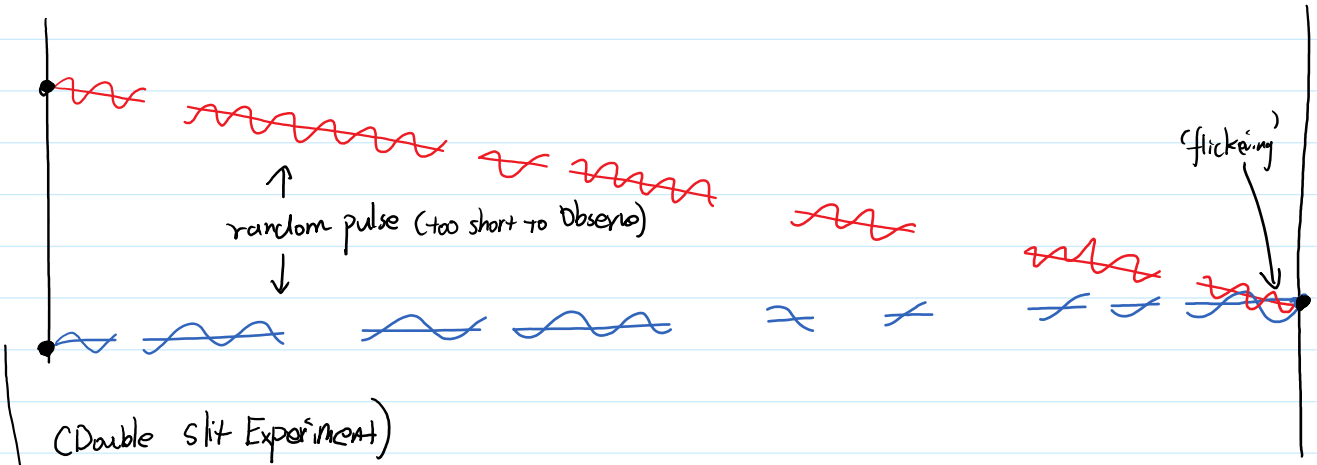
LAISER is only coherent source.

light should not be a wave?

These are not coherent sources

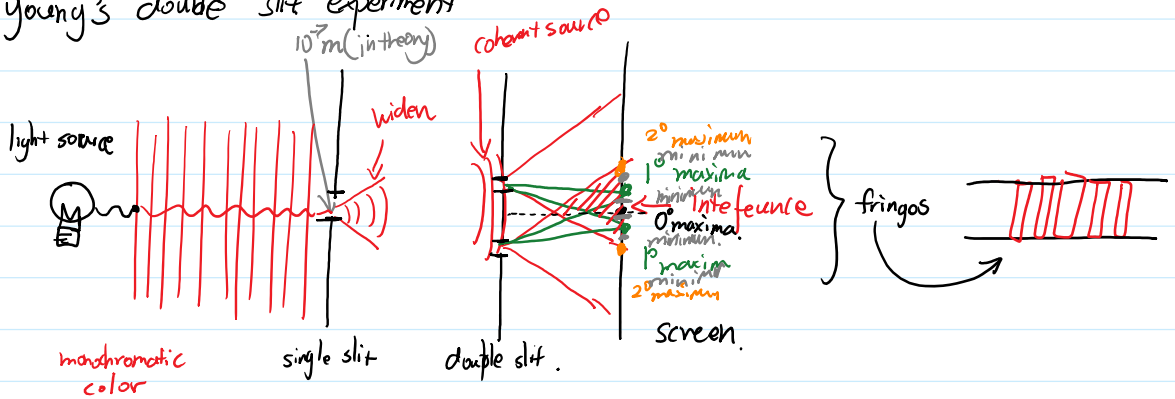
young's double slight experiment

} prove is a wave by get interference



(Double slit Experiment)

young's double slit experiment



} fringes

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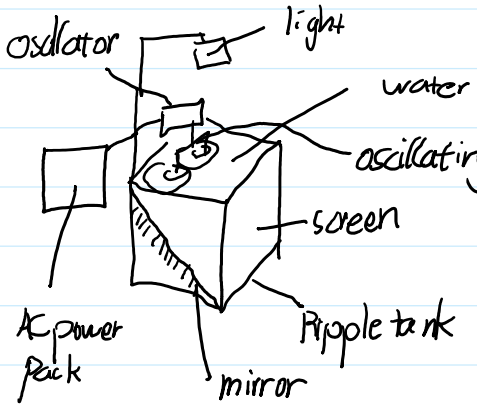
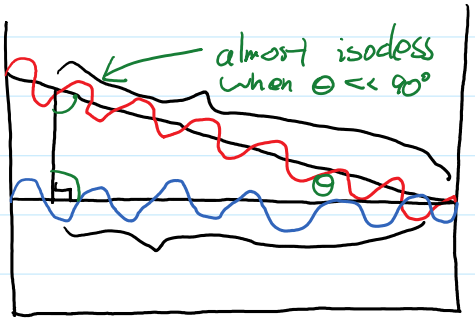
2018年3月23日 7:56

Demonstration of superposition



Path difference in unscale

Coherent: constant in time phase difference



Count the difference

and calculate the path difference

Young's double slit Experiment

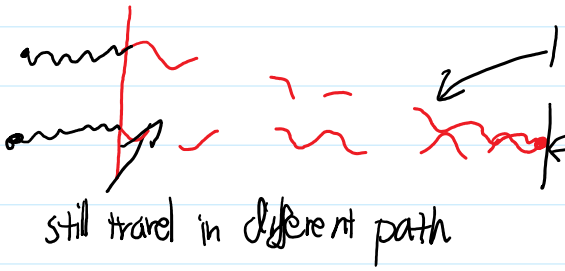
Why can't we add RGB to white?
dipplet must be precisely/light is not a single source

dispersion

- normal light has multiple wavelength, so do not show signs of superposition
  (therefore 2 century ago, they think it is light ray
- Thomas Young prove that light is a wave by this double slit Experiment

But why don't the filter work?

they are not coherent



light travel at random pulse

arrive at random gap, so not able to show interference (no natural source of coherent light)

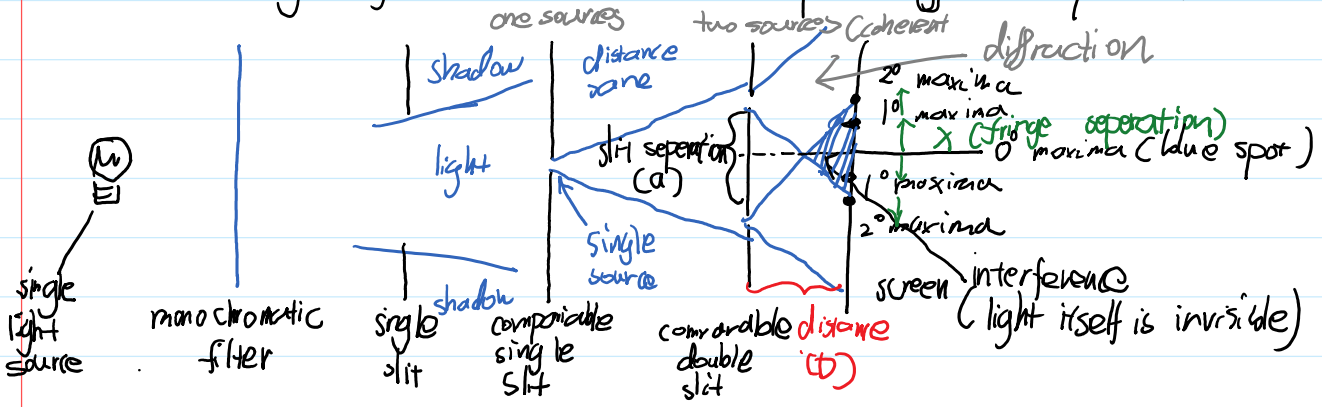
still travel in different path

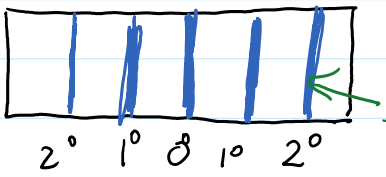
But thoms young don't have it → pulses with equal distance (phase difference the same) LAISER

he use a single light source to avoid the path difference problem

one source

he use a single light source to avoid the path difference problem





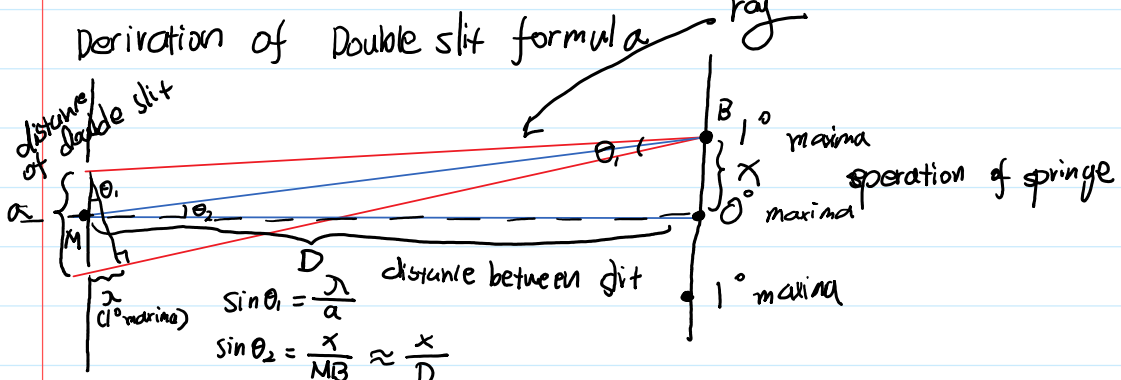
← maxima & minima (light is a wave)

fringes allow us to calculate λ of light

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

Double slit formula (You need to remeber this)

Deriviation of Double slit formula



$\because$ △Blue ∽ △Red

and θ_1 and θ_2 are small ⟹ this is the primary reason

therefore $\sin\theta_1 \approx \sin\theta_2$

$\therefore \frac{\lambda}{a} = \frac{x}{D} \Leftrightarrow \lambda = \frac{ax}{D}$

only: $D >>>> x >>>> a$

$(D > 1m)$

Diffraction Gratting

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

with the same distance

a | a | a | a | a |

many slit that have some seperation

label : 80 slit in 1mm

$d = \frac{1}{80}$ mm

$$\sin\theta_1 = \frac{\lambda}{a}$$

a { | | | | |

diffracting grating

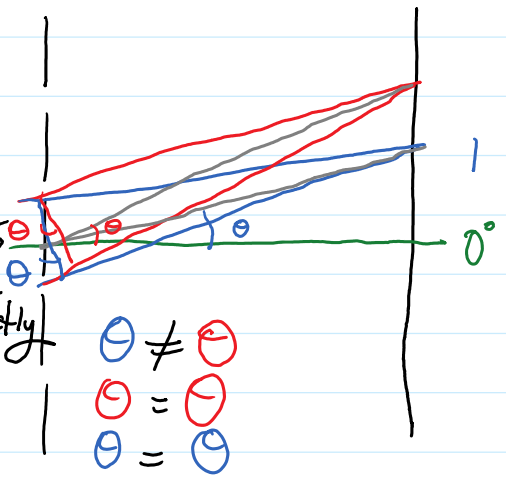
slit distance for diffracting grating (spacing)

$\sin\theta_1 = \frac{\lambda}{a}$

$a \sin\theta_1 = \lambda$

$d \sin\theta_1 = n\lambda$

n^{th} maxima



these two can't get directly

d- grating spacing

n- number of maxima

θ- angle between 0° maxima and n° maxima.

example:

80 lines/mm

① find the diffracting spacing

$d = \frac{1}{80} \times 10^{-3} m = 1.25 \times 10^{-5} m \quad (a = 1.25 \times 10^{-5} m)$

constant constant

$\lambda = \frac{ax}{D}$ ↓ ↓

$\lambda = \frac{ax}{D}$ ↓ ↑ constant constant

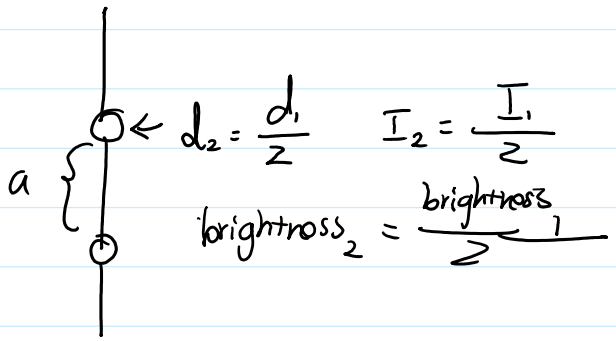
$\downarrow \lambda = \frac{ax \downarrow}{D}$ constant constant

Finding biggest number of maxima

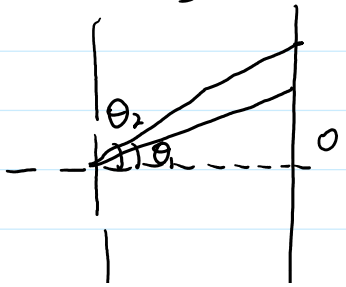
$d\sin\theta = n\lambda$ $\sin\theta = 1$

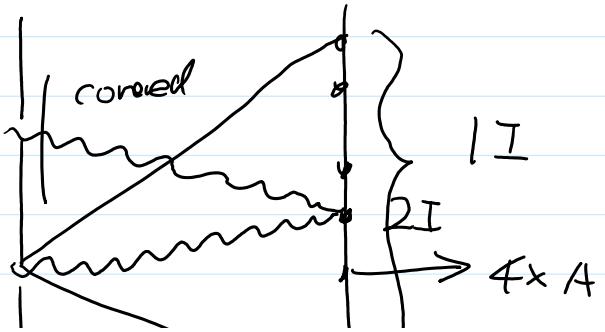
$\frac{d\sin\theta}{\lambda} = n$

$n = \left\lfloor \frac{d}{\lambda} \right\rfloor$



n° & $(n+1)^{\circ}$ maxima






4x A

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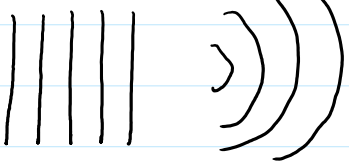
Standing / Stationary Waves

shape of wavefront: plan, circular



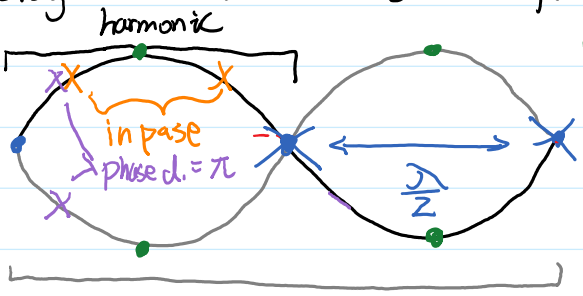
shape of wave

Transport of Energy:

- progressive — transport energy

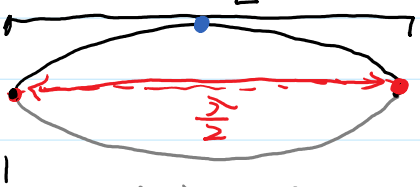
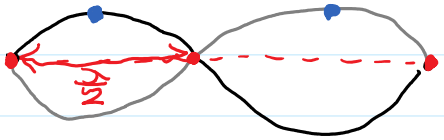
- stationary — NOT transport energy (main properties ↙ SAVE energy)

Stationary wave is result of superposition / interference (preferred) between a progressive wave and its reflection

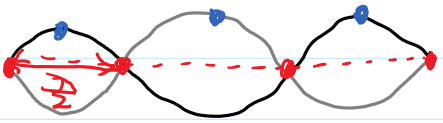


antinodes - result of constructive superposition between two way — A = maximum

nodes - result of destructive superposition between the two way — A = 0

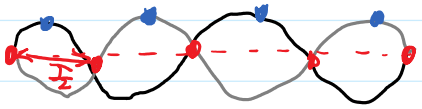
harmonic wave	frequency	nodes	antinodes	wavelength
 n=1 reflective wave	f_0	2	1	$2L$
 n=2	$2f_0$	3	2	$\frac{2L}{2} = L$

n=2



n=3

n=4



n=X

$3f_0$	4	3
$4f_0$	5	4
nf_0	$n+1$	n

$\frac{2L}{3}$

$\frac{2L}{4} = \frac{L}{2}$

$\lambda = \frac{2L}{n}$

wavelength is the double distance of two adjacent wave

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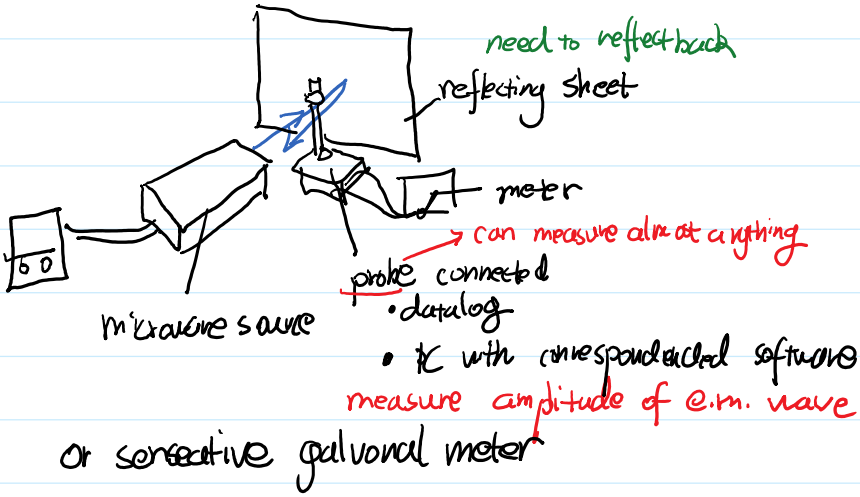
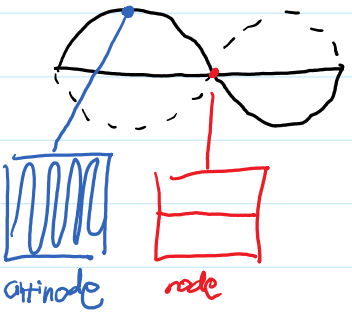
2018年3月30日 8:48

$\lambda = \frac{2L}{n}$

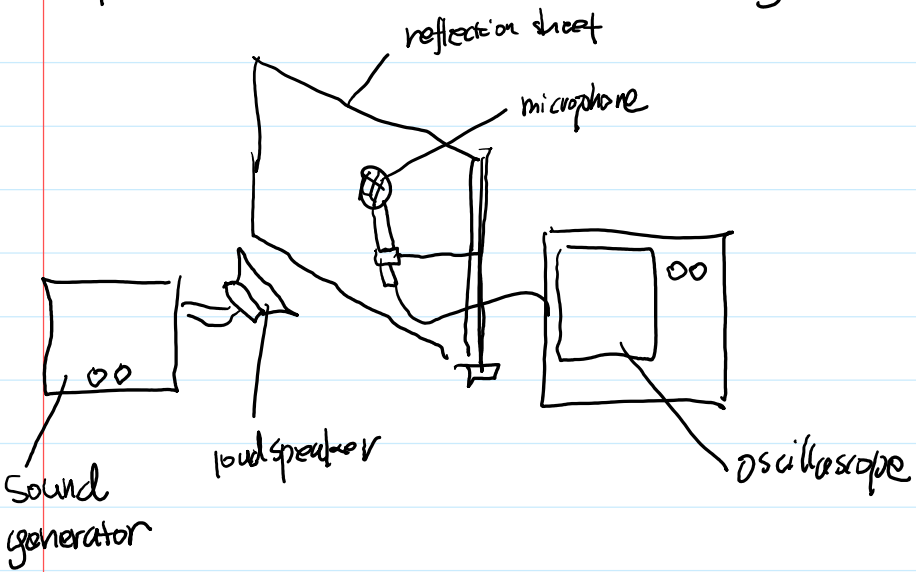
Experiment to demonstrate the microwave standing waves

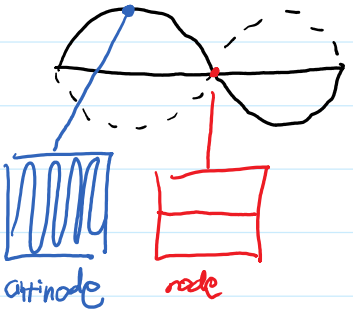




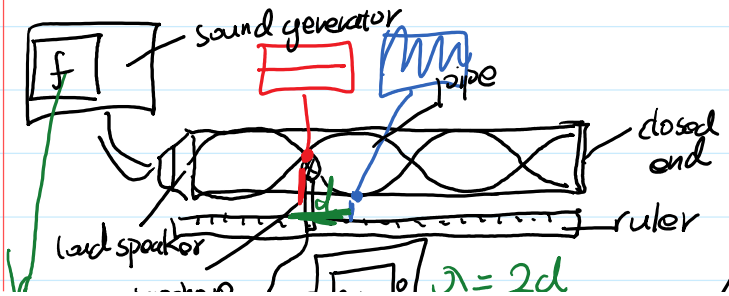
or sensitive galvanol meter

Experiment to demonstrate the sound standing waves

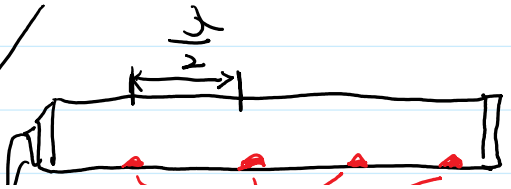


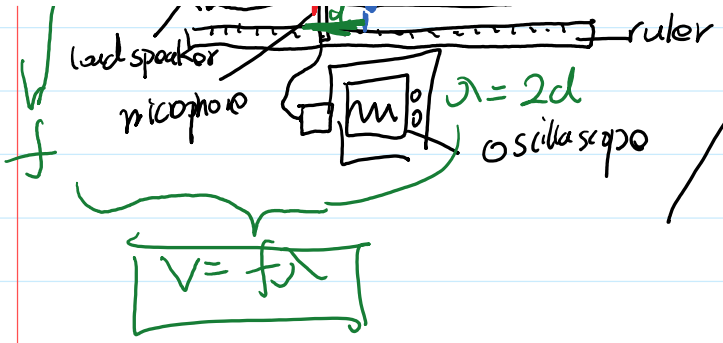


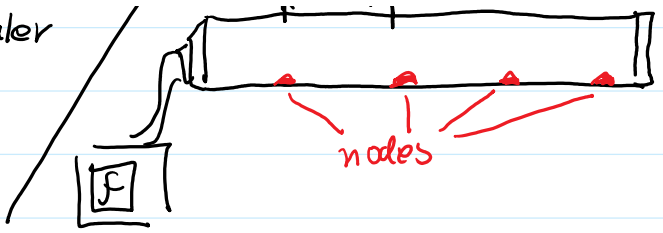
Experiment to find sound speed from sound wave



Kundt's Dust Tube

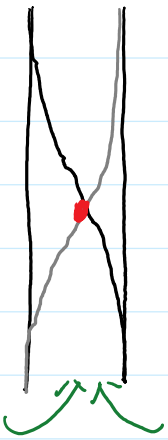






Standing Waves @ Pipes

opened ends



$L = \frac{\lambda}{2} \Rightarrow \lambda = 2L$

air pumped in to superpose

f higher

closed ends

$L = \frac{\lambda}{4} \Rightarrow \lambda = 4L$

f lower

how to get rid of C $\begin{cases} \frac{\lambda}{4} = L_1 + C \\ \frac{3\lambda}{4} = L_2 + C \end{cases}$

$\Rightarrow$ solve for C $\frac{\lambda}{2} = L_2 - L_1$

get rid of

4/2

2018年4月2日 15:53

Base Unit	Base Quantity
• m	• distance
• s	• second
• kg	• mass — measure of inertia
• A	• Current — rate of flow of charge
• mol	• number of substance
• cd	• illuminous intensity
• K	• thermodynamic temperature

World War

Definition for energy

$P = \frac{E}{t}$

$F = ma$

$P = \frac{F}{A}$

Define watt

$W = \frac{1J}{1s}$ ⇒ watt is such the power to use 1J in 1s

$N = 1kg\,ms^{-2}$ ⇒ Newton is such that force that 1kg of mass accelerate to $1m/s^2$

$Pa = 1N/m^2$ ⇒ 1Pa is such a pressure when 1N force act on $1m^2$ area

Express Via base Unit

$V = \frac{E}{Q} = \left[\frac{J}{C} = JA^{-1}s^{-1} = kgm^2s^{-2}s^{-1}A^{-1} = kgm^2s^{-3}A^{-1}\right]$ (J → Nm)

$k = \frac{F}{x} = \left[\frac{N}{m} = \frac{kgms^{-2}}{m} = kgs^{-2}\right]$

Homogeneous equation

$T = 2\pi\sqrt{\frac{L}{g}}$

$s = \sqrt{\frac{m}{ms^{-2}}} = \sqrt{s^2} = s$

erros:

- systematic e. ⇒ all measurement are wrong
- random e. ⇒ a few are wrong (discard)
- zero e. ⇒ all bigger/smaller

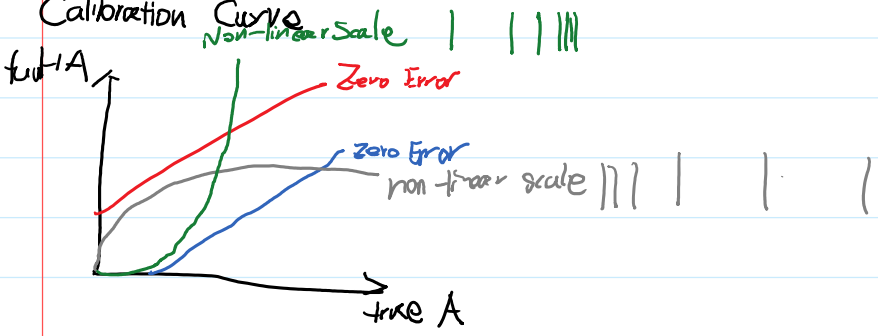
Zero e. ⇒ all bigger/smaller

Precision ⇒ tells about smallest division of your measuring instrument
(if the result are close together, then it's precise).

reliable ⇒ repeate measurement and found average

accuracy ⇒ results are close to true result.

Calibration Curve



Δx ⇒ uncertainty

$\frac{\Delta x}{x}$ ⇒ percentage/fractional Uncertainty

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2018年4月11日 9:32

(not vector!) F = -F

Vector! (could be also represent by F)

- kinematics — how object moves
- Equilibrium — not moving and not rotating
- Dynamics — why the object moves (forces)

$\sum F = 0$ in any direction

N1 an object will remain at rest or keep travelling at constant speed unless it acted on resultant force

$\sum F = 0 \Rightarrow$ • v = 0 / v = constant

N2 resultant force acting on an object equals rate of change of linear momentum

$\sum F = \frac{\Delta mv}{t} = ma$ [1] change of momentum and resultant force in same direction

N3 …… the other is equal and opposite

→ to change speed it
- accelerate
- decelerate
- change in direction

• $\sum M_{clock} = \sum M_{anticlock}$ in any pivot

Mass ⇒ measure of inertia (tendency of object to move) (kg)

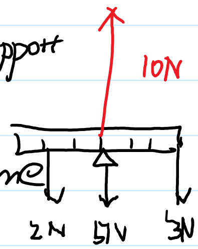
Weight (N) exerted by me, acting on support

Force $W = mg$ ⇒ gravational field strength

force of gravity (N) exerted by planet, acting on me

$F = mg$

10N Reaction force



Terminal Velocity air resistance present

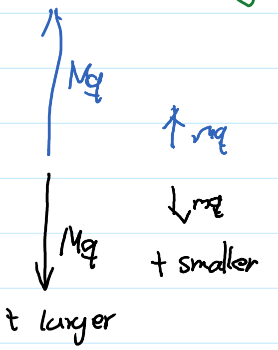
takes time

constant speed reached when driving force equals V increased drag

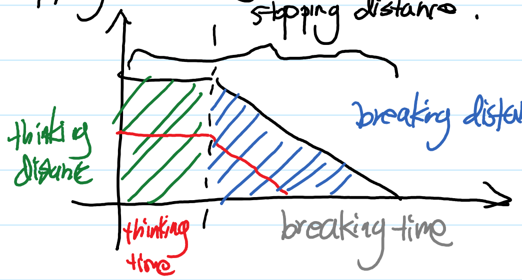
time of falling when not reached V_t will be not affect

9.8 N/kg — force of gravity acting to 1kg — numerically two same

But if long enough the mass will develop different V_t



Stopping distance



Starting velocity will be affect

Types of forces

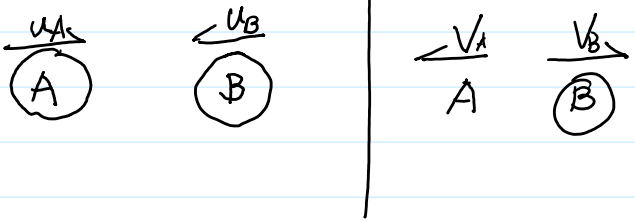
- contact
- non-contact acting through fields

- contact
- non-contact — acting through fields
  - fundamental
    - gravitational force — kingdom of hadron elementary particles: lepton, quark
    - strong force
    - weak force — kingdom of lepton particles
    - electromagnetic force
  - non-fundamental
    - origin of non fundamental force
      - friction → electromagnetic
      - Tension → electromagnetic (IMF)
      - Upthrust → difference of pressure on up and down
      - lift → pressure difference
      - air resistance → particles bombarding moving object

β decay

Momentum

- product of mass and velocity
- principle of conservation of momentum



collision

$$F_A = \frac{m_A v_A - m_A u_A}{t}$$ force exerted by B

$$F_B = \frac{m_B v_B - m_B u_B}{t}$$ force exerted by A

$$F_A = -F_B \Rightarrow \frac{m_A v_A - m_A u_A}{t} = -\frac{m_A v_B - m_B u_B}{t}$$

time and interaction are same

$$m_A v_A - m_A u_A = -(m_B v_B - m_B u_B) \Rightarrow \sum mv = \sum mu$$

elastic collision: energy before = energy after (gpe are assumed)

Relative Speed Remains the Same

- 2D collisions
  - take horizontal axis
  - take vertical axis

Moments

mass

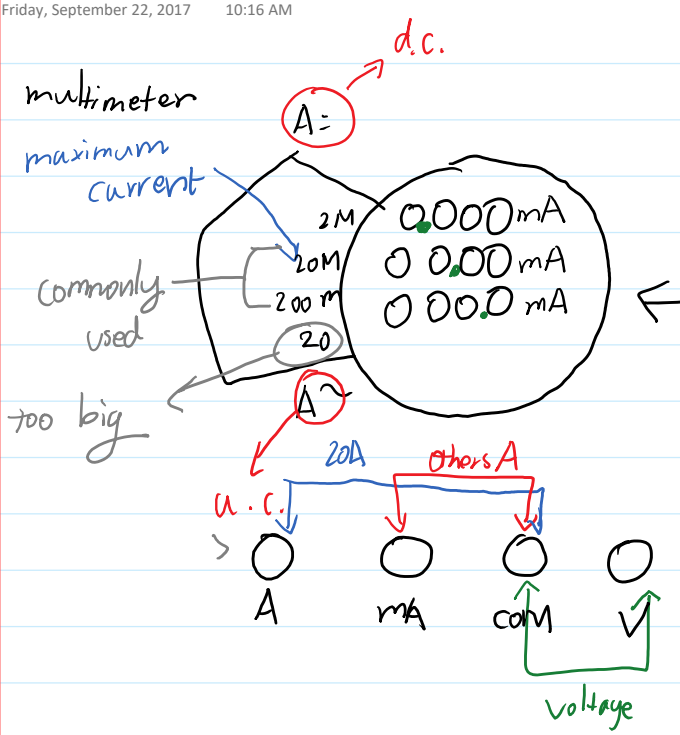
Moments

- centre of mass appear to be concentrated (mass)
- centre of gravity appear to be concentrated (weight)

Stability

Practical Skills

Friday, September 22, 2017 10:16 AM



← This will be set during test, and you should Not change it

If the reading is not correct (in correct circuit) then help will not reduce [1] → in this case you can ask for replacement

otherwise you will loose [1]

table → use correct order to show trend

- [5] 6 set of table + no help + correct trend
- [1] headings — distinguish mark; Unit; R/Ω | I/A | $\frac{1}{I}/A^{-1}$ (use 10^{-3}/mA)
- [1] range
  - biggest * (118 Ω)
  - smallest * (12 Ω)
  - somewhere in the middle → use 80% of varying

  0.0069 ✗ not allowed
- [1] consistancy of raw data
- [1] S.f. for calculation ⇒ same number of decimal place
- [1] calculation

Do Not Cross the Data! ⇒ use pencil to write data first HB pencil

write $\text{gradient} = \frac{\Delta y}{\Delta x}$ ⇒ use big enough (over half) triangle, and not the original result (use dotted line to show the result)

and then $\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - y_1}$ [1]

for false origin / negative ⇒ show calculation

Graph

- [1] Scaling
  - labelled axis
  - number on every far line
  - number are multiple of ×1 / ×2 / ×4 / ×5 / ×10
  - estimate for occupation of minimum $\frac{1}{2}$ (point)
- [1] plots → accurate cross for correct number
- [1] line of best fit (Σdistance of point above line = Σ distance of point below line)
- [1] quality → better not to have abnormal point are close to the line