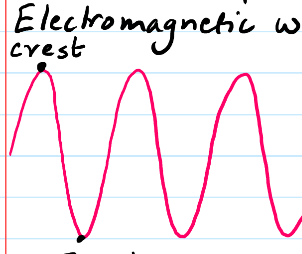
Waves

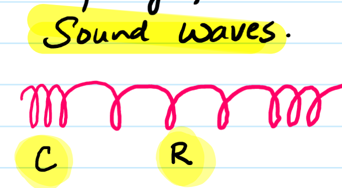
Progressive Wave
* waves which travel or move & as they move they transfer energy from one pt to another pt.

Stationary Wave
not done in O-level but it is a part of AS Level.

Transverse
· direction of vibration is perpendicular to the direction in which wave travels.
eg Water waves, waves on ropes, Electromagnetic waves

Longitudinal
· direction of vibration is parallel to the direction in which wave travels
eg waves on Springs, Sound waves.





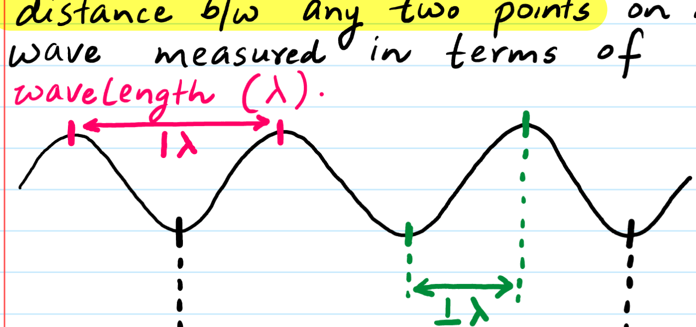
C = Compression
R = Rarefaction.

· Properties of Waves

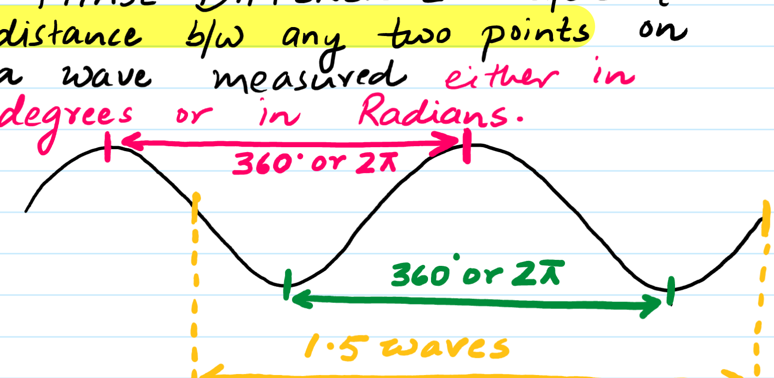
① Reflection } O-level
② Refraction

③ Superposition } AS-level.
④ Interference
⑤ Diffraction

· PATH DIFFERENCE :- refers to distance b/w any two points on a wave measured in terms of wavelength (λ).

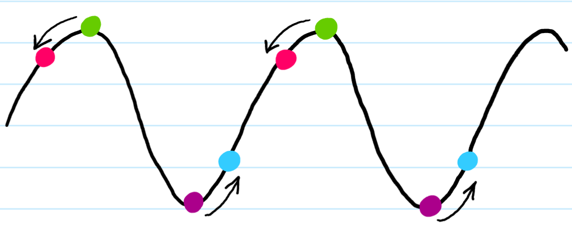


· PHASE DIFFERENCE :- refers to distance b/w any two points on a wave measured either in degrees or in Radians.



· A path diff of 1λ corresponds to a phase diff of $360°$ / 2π rad.

· What are In-phase pts :- Two pts if upon comparision exhibit identical / similar behaviour than they are said to be in phase with each other

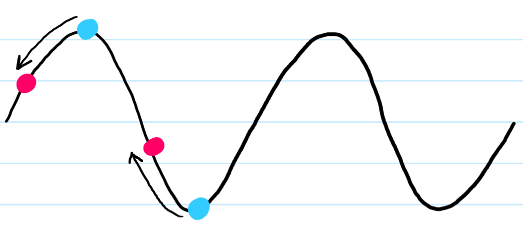


examples could be a Crest if compared with another Crest or a Trough if compared with another trough.

① For In-phase pts, they must have a path difference of 1λ, 2λ, 3λ, 4λ, 5λ, 6λ, 7λ .... and they must have a corresponding phase difference of 2π, 4π, 6π, 8π, 10π ....

$1\lambda, 2\lambda, 3\lambda, 4\lambda, 5\lambda, 6\lambda, 7\lambda, 8\lambda$ } In phase
$2\pi, 4\pi, 6\pi, 8\pi, 10\pi$

· What are Out-of phase pts :- Two pts if upon comparision exhibit exactly opposite behaviour than they are said to be out-of phase with each other



example could be a Crest if compared with a trough.

② For Out-of phase pts, they must have a path difference of $\frac{1}{2}\lambda, \frac{3}{2}\lambda, \frac{5}{2}\lambda, \frac{7}{2}\lambda, \frac{9}{2}\lambda, \frac{11}{2}\lambda$ ... and $\frac{1}{2}\lambda$, 1.5, 2.5, 3.5, 4.5, $\frac{11}{2}\lambda$

they must have a corresponding phase difference of π, 3π, 5π, π, 3π, 5π, 7π, 9π, 11π, 7π, 9π, 11π.

Example Question

$V = 640ms^{-1}$
$f = 800Hz$

Cal. the PHASE DIFF b/w 2 pts on this wave which are seperated by a distance of 0.4 m.

$v = f\lambda$
$\frac{640}{800} = \lambda$ $\lambda = \frac{v}{f}$
$\lambda = 0.8m$

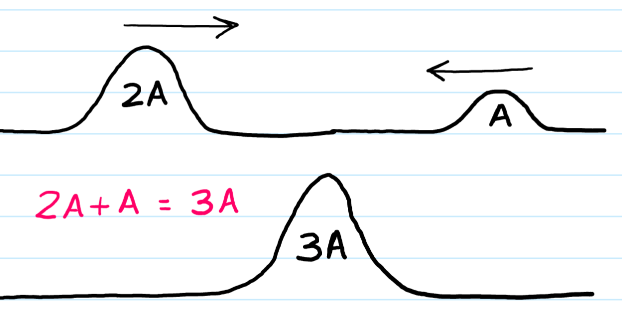
1 wavelength $1\lambda\ (0.8m) \longrightarrow 360°/2\pi$
$0.4m \longrightarrow 180°/\pi$ ANS.

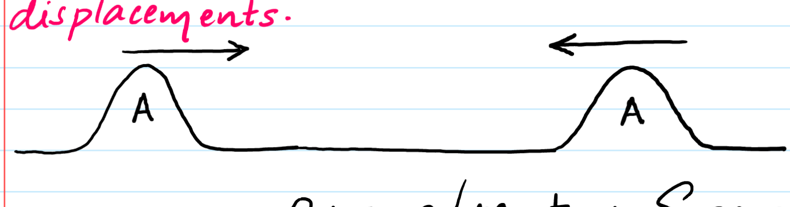
Super impose
Two waves → Overlap.
meet
mapping on top of each other

① Superposition :-

Principle of Superposition :-

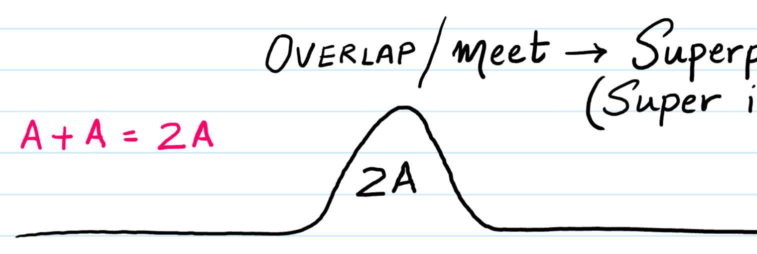
According to the principle of Superposition, if two or more waves overlap / meet at a common pt, than the Total displacement due to these waves will be the sum of their individual displacements.





OVERLAP / meet → Superposition (Super impose)

A + A = 2A



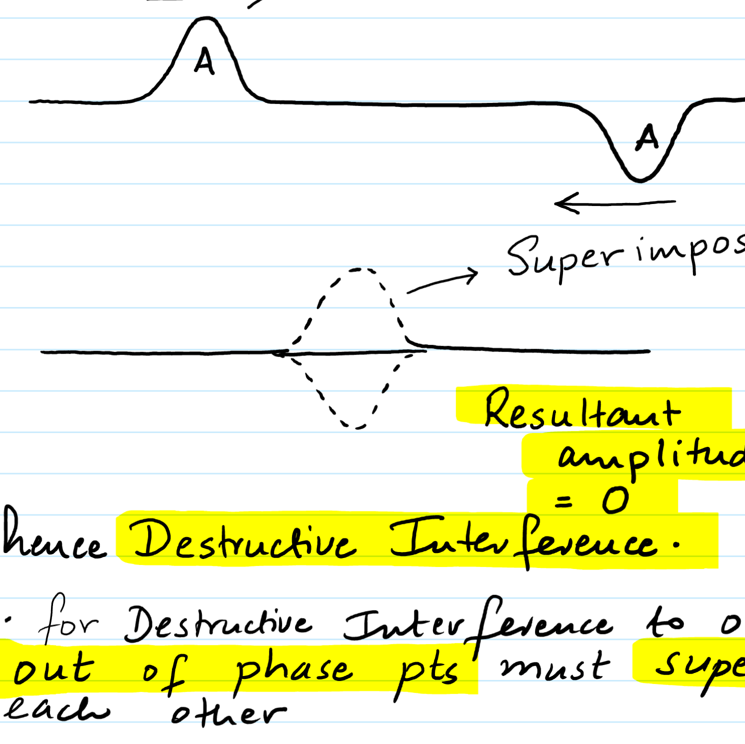
· The phenomena of Superposition gives rise to "INTERFERENCE". The above case can be classified by the term "CONSTRUCTIVE" interference

· Constructive Interference occurs when IN PHASE pts superimpose each other.

· for Constructive Interference to occur we can say that path diff will be $1\lambda, 2\lambda, 3\lambda, 4\lambda, 5\lambda; 6\lambda$ & phase diff will be $2\pi, 4\pi, 6\pi, 8\pi$ ....

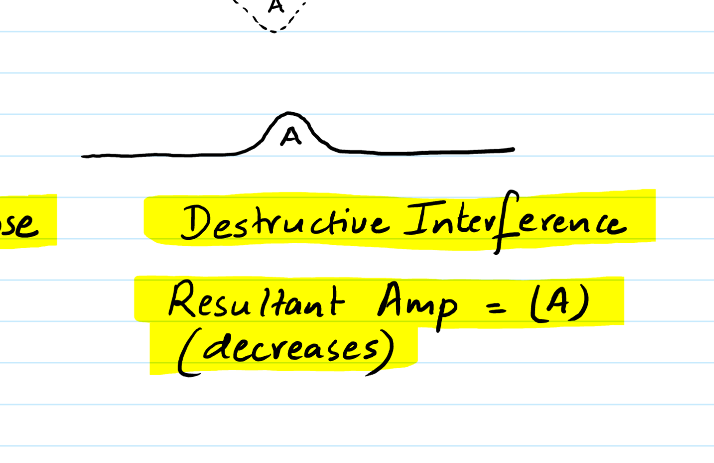
What about Destructive Interference

Think of a crest amplitude (A) over-lapping with a Trough amplitude (A). as shown



Resultant amplitude = 0

hence Destructive Interference.



· for Destructive Interference to occur, out of phase pts must superimpose each other

Destructive Interference

Resultant Amp = (A) (decreases)

· for Destructive Interference, the path difference corresponds to $\frac{1}{2}\lambda, \frac{3}{2}\lambda, \frac{5}{2}\lambda, \frac{7}{2}\lambda, \frac{9\lambda}{2}$ .... and the phase difference corresponds to $\pi, 3\pi, 5\pi, 7\pi, 9\pi$ ....