

Waves

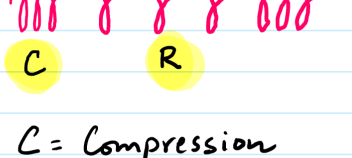
**Progressive Wave**  
\* waves which travel or move & as they move they transfer energy from one pt to another pt.

**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.

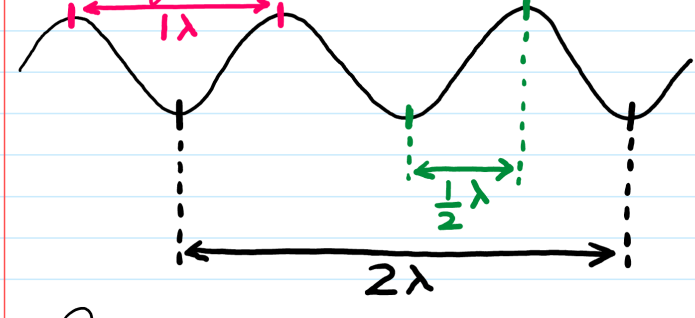


C = Compression  
R = Rarefaction.

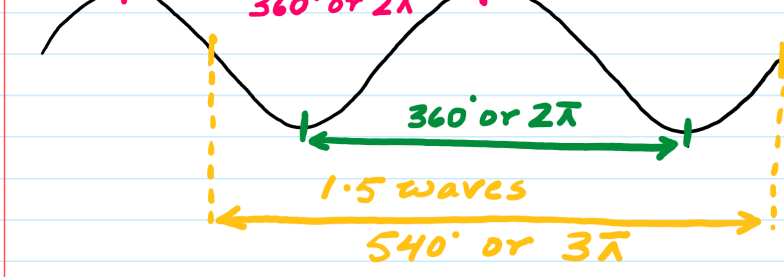
Properties of Waves

- ① Reflection } O-level
- ② Refraction } O-level
- ③ Superposition } AS-level.
- ④ Interference } AS-level.
- ⑤ Diffraction } AS-level.

**PATH DIFFERENCE** :: refers to distance b/w any two points on a wave measured in terms of wavelength ( $\lambda$ ).

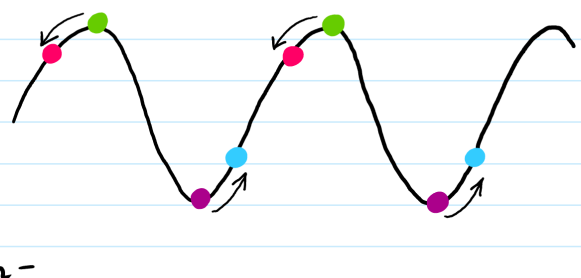


**PHASE DIFFERENCE** :: refers to distance b/w any two points on a wave measured either in degrees or in Radians.



A path diff. of  $1\lambda$  corresponds to a phase diff. of  $360^\circ / 2\pi$  rad.

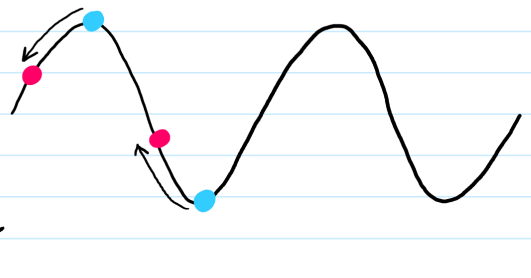
What are In-phase pts :: Two pts if upon comparison exhibit identical / similar behaviour than they are said to be in phase with each other



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  $1\lambda, 2\lambda, 3\lambda, 4\lambda, 5\lambda, 6\lambda, 7\lambda, \dots$  and they must have a corresponding phase difference of  $2\pi, 4\pi, 6\pi, 8\pi, 10\pi, \dots$

What are Out-of phase pts :: Two pts if upon comparison 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  $\frac{1}{2}\lambda, \frac{3}{2}\lambda, \frac{5}{2}\lambda, \frac{7}{2}\lambda, \frac{9}{2}\lambda, \frac{11}{2}\lambda, \dots$  and  $\frac{1}{2}\pi, 1.5\pi, 2.5\pi, 3.5\pi, 4.5\pi, \dots$  they must have a corresponding phase difference of  $\pi, 3\pi, 5\pi, 7\pi, 9\pi, 11\pi, \dots$

Example Question

$v = 640 \text{ms}^{-1}$   
 $f = 800 \text{Hz}$   
 $v = f\lambda$   
 $\frac{640}{800} = \lambda$   
 $\lambda = 0.8 \text{m}$

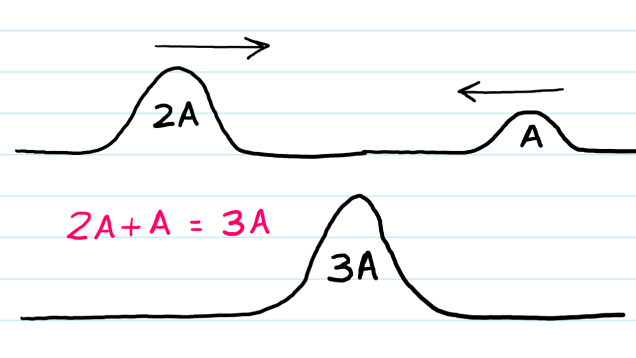
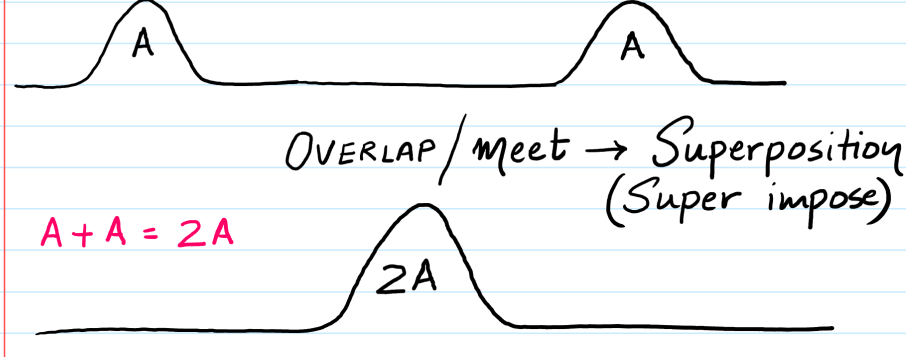
Cal. the PHASE DIFF b/w 2 pts on this wave which are separated by a distance of  $0.4 \text{m}$ .

1 wavelength  $1\lambda (0.8 \text{m}) \rightarrow 360^\circ / 2\pi$   
 $0.4 \text{m} \rightarrow 180^\circ / \pi$  Ans.

① Superposition :: Super impose Two waves meet Overlap. mapping on top of each other

Principle of Superposition :-

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



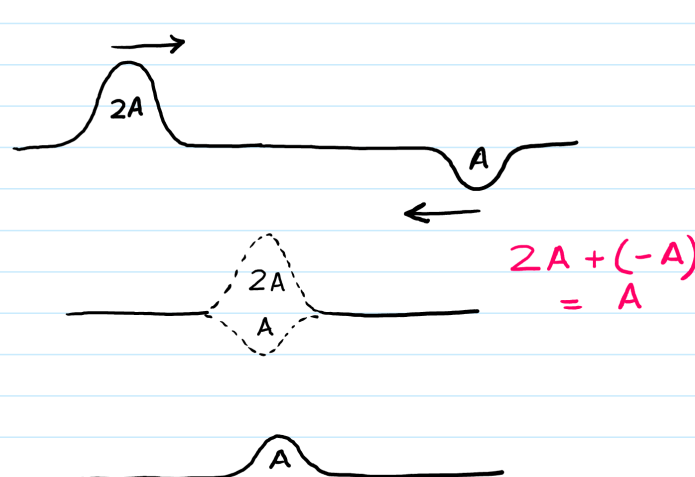
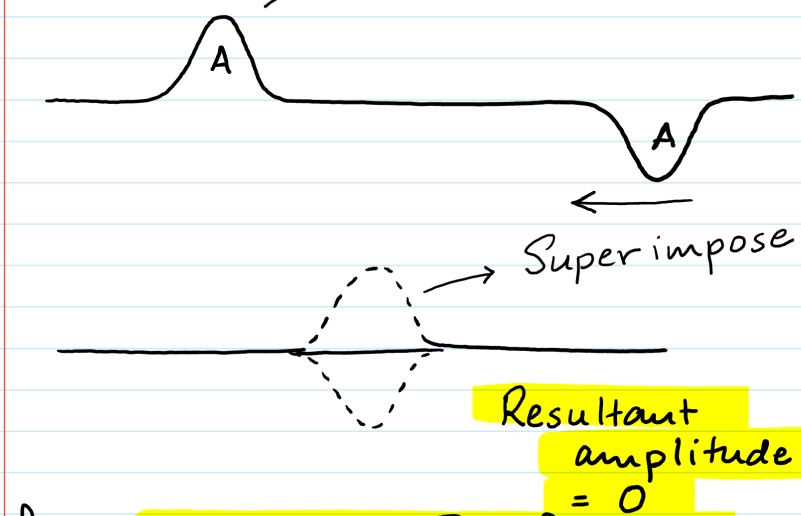
The phenomena of Superposition gives rise to "INTERFERENCE". The above case can be classified by the term "CONSTRUCTIVE" interference

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  $2\pi, 4\pi, 6\pi, 8\pi, \dots$

What about Destructive Interference

Think of a crest amplitude (A) overlapping with a Trough amplitude (A).



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  $\frac{1}{2}\lambda, \frac{3}{2}\lambda, \frac{5}{2}\lambda, \frac{7}{2}\lambda, \frac{9}{2}\lambda, \dots$  and the phase difference correspond to  $\pi, 3\pi, 5\pi, 7\pi, 9\pi, \dots$