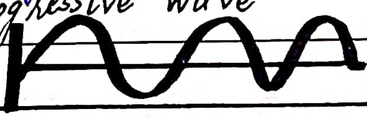
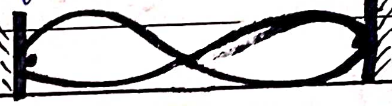
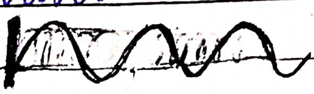
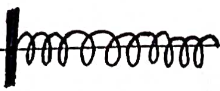
Q. No. 2 (i)

Progressive waves	Stationary waves
Reason of Production	
Disturbance in a medium.	Superposition of 2 waves moving in opposite direction.
Transmission of energy	
Transmits energy	Doesn't transmit energy.
Motion of wave profile	
Wave profile moves.	Waves profile doesn't move.
Amplitude	
Same amplitude	Different amplitude.
Nodes and antinodes	
They aren't present.	They are present
Diagrams	
Progressive wave 	Stationary wave 

Q. No. 2 (ii)

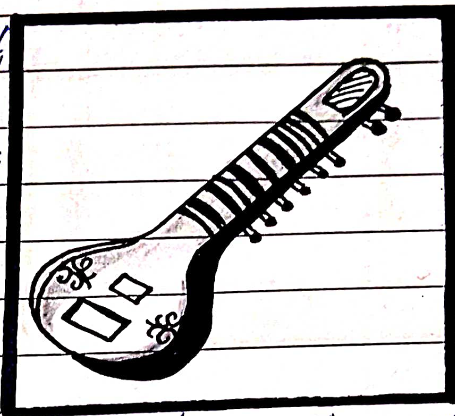
Transeverse waves	Longitudinal waves
Components	
Consists of crests and troughs	Consists of compressions & rarefactions.
Direction of propagtion	
Perpendicular.	Parallel.
Polarisation	
Can be polarized.	Cannot polarized
Pressure variations	
No pressure variations.	Pressure variation takes place.
Change in density	
No change.	Change takes place
Examples	
Light wave. 	Sound wave 

Q. No. 2 (iii) **Tuning of musical instrument**

Process:- •- Beat the instrument against a note of known frequency.

•- If two frequenice differ slightly, beats will be produced.

•- Adjust the frequency of the untuned instrument by **tightening** or **loosening** the string.



•- When **no beats** are heard, the musical instrument will produce the note of desired frequency.

Conclusion:- The tuned object would show synchronization.

Q. No. 2 (iv) **Production of stationary waves:-** When two similar waves pulses are travelling in opposite direction and they superpose each other, stationary waves are produced.

Nodes & anti-nodes:- Consists of nodes and antinodes. At node amplitude of vibration is zero.

No transfer of energy:- There is no transfer of energy through the medium due to nodes.

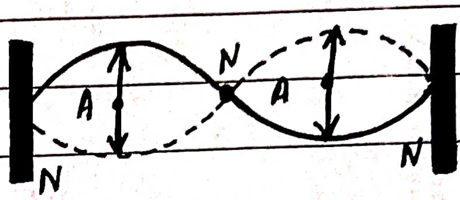
Inter-conversion of energies:- Only interconversion of K.E and P.E takes place.

•- Kinetic energy is maximum at mean.

•- Potential energy is maximum at extreme.

Q. No. 2 (v) **Nodes:-** 1) In stationary waves, **the displacement of vibration is zero** and tension is maximum at the node.

2) The nodes are at rest and located at the ends of each loop as shown in figure.



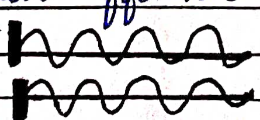
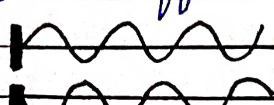
$L = \lambda = \frac{2\lambda}{2}$

Antinodes:- 1) At the antinode, the **amplitude of vibration is maximum** and tension is minimum.

2) The antinodes are located at the mid of each loop where amplitude of vibration is maximum.

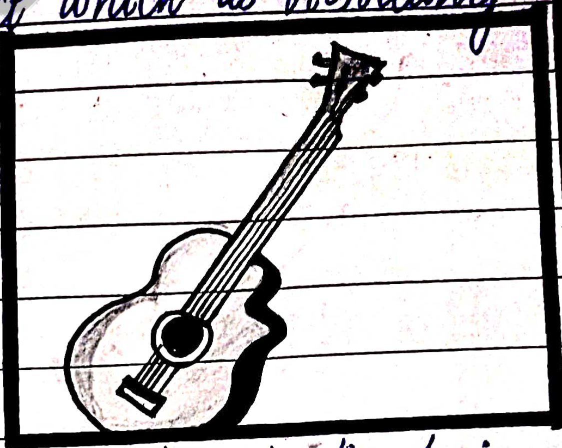
Q. No. 2 (vi)

Conditions

Constructive interference		Destructive interference
	Location of crest & trough	
One crest of one wave falls on crest of other same for trough.		One crest of one wave falls on trough other wave.
	Path difference	
zero or integral multiple of wavelength.		odd integral multiple of half of wavelength.
	Coherent	
Shows coherency.		Shows coherency.
	Direction	
Remains same.		Remains same.
	Mathematically	
Path difference $= m\lambda$		Path difference $= (m + \lambda/2)$
	Diagram	
		

Q. No. 2 (vii) Yes.

Reason:- It is possible for an object which is vibrating transversely to produce sound wave.



- All the string type musical instruments when played, produces transverse waves.
- And the energy from these vibrating instruments travels through air in the form of sound waves which are longitudinal in nature.

For example:- A guitar and violin works on the same principal.

Conclusion:- But the disturbances these waves produce vibration in air particle which produce longitudinal waves.

Q. No. 2 (viii) **Explanation:-** If E is elastic modulus and ρ is density of medium speed of sound waves will be,

$$v = \sqrt{\frac{E}{\rho}}$$

- Although density of solid is greater than gases, but elasticity is very greater in solid as compared to gases,

$$\left[\frac{E}{\rho}\right]_{solids} > \left[\frac{E}{\rho}\right]_{gases}$$

- Also molecules are closer in solids than in gases, so they respond more **quickly** to a disturbance.

Conclusion:- Sound moves faster in solid because of high elastic modulus.

Q. No. 2 (ix) The speed of sound in a gas at temperature T (in kelvin) is given by.

Mathematically:-

$$v = \sqrt{\frac{\gamma RT}{M}}$$

$$v \propto \sqrt{T}$$

(As $\sqrt{\frac{\gamma R}{M}}$ = constt)

•- The speed of sound is ∝ square root of temperature in kelvin.

Conditions:- 1) When temperature increase sound's speed also increase.

2) When temperature decrease sound's speed also decreases.

The speed of sound increases 0.61 m/s with 1°C rise in temperature according to the equation.

$$v_t = v_0 + 0.61t$$

Q. No. 2 (x) **Reason:-** No, it is not possible for two astronauts to talk directly to one another if they remove their helmets.

Longitudinal nature of sound waves:- This is because of longitudinal nature of sound waves.

i) They require medium for propagation which is not available in this case.

No direct communication:- No, direct communication is possible without helmets. Because sound waves don't travel in vaccum.

Conclusion:- Thus, no direct communication is possible for astronauts if they remove their helmets.

Q. No. 2 (xii) **Data:-**

Length of tube = $L = 15cm = 0.15m$

Speed of sound at $0°C = 332ms^{-1}$

To find:-

Estimate frequencies = ?

Solution:-

$$f_1 = \frac{V}{4L}$$

$$f_1 = \frac{332}{4 \times 0.15}$$

$$f_1 = 553Hz$$

$$f_2 = 3f_1$$

So,

$$f_2 = 3 \times 553$$

$$f_2 = 1660Hz$$

$$f_3 = 5f_1$$

So,

$$f_3 = 5 \times 553$$

$$f_3 = 2765Hz$$