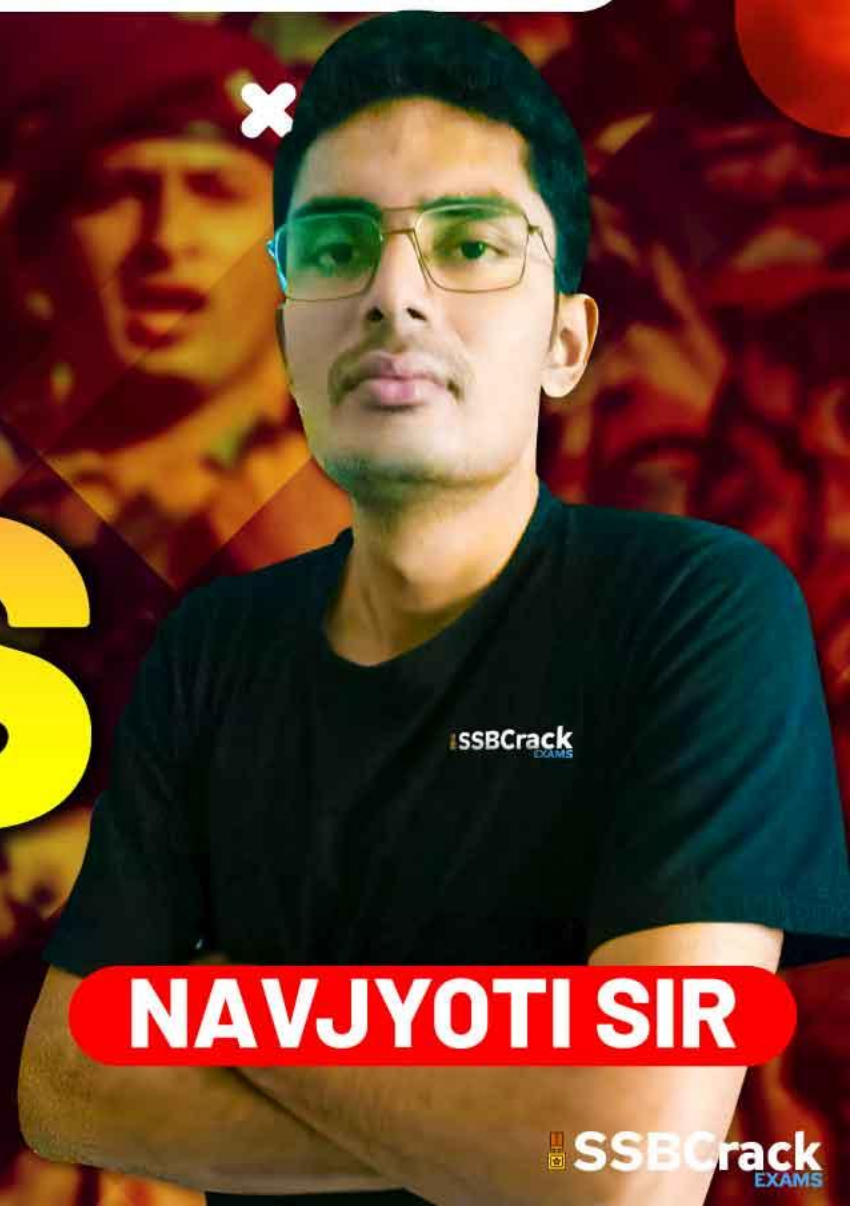
NDA-CDS 1 2025

GS

LIVE

PHYSICS

WAVES



NAVJYOTI SIR

SSBCrack EXAMS

06 Dec 2024 Live Classes Schedule

8:00AM	06 DEC 2024 DAILY CURRENT AFFAIRS	RUBY MA'AM
9:00AM	06 DEC 2024 DAILY DEFENCE UPDATES	DIVYANSHU SIR

SSB INTERVIEW LIVE CLASSES

9:30AM	OVERVIEW OF PPDT & PRACTICE	ANURADHA MA'AM

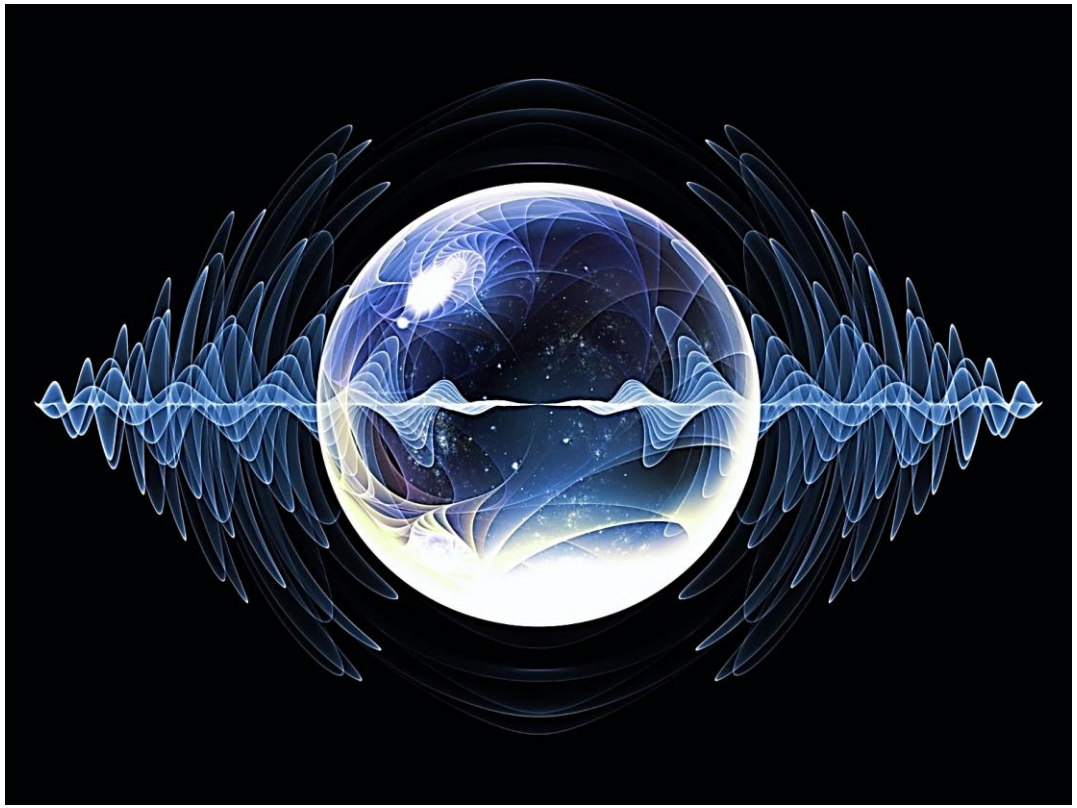
NDA 1 2025 LIVE CLASSES

1:00PM	PHYSICS - WAVES	NAVJYOTI SIR
4:30PM	ENGLISH - SYNTHESIS OF SENTENCES - CLASS 2	ANURADHA MA'AM
5:30PM	MATHS - DIFFERENTIABILITY & DIFFERENTIATION - CLASS 3	NAVJYOTI SIR

CDS 1 2025 LIVE CLASSES

1:00PM	PHYSICS - WAVES	NAVJYOTI SIR
4:30PM	ENGLISH - SYNTHESIS OF SENTENCES - CLASS 2	ANURADHA MA'AM
7:00PM	MATHS - ALGEBRA - CLASS 3	NAVJYOTI SIR

WAVES

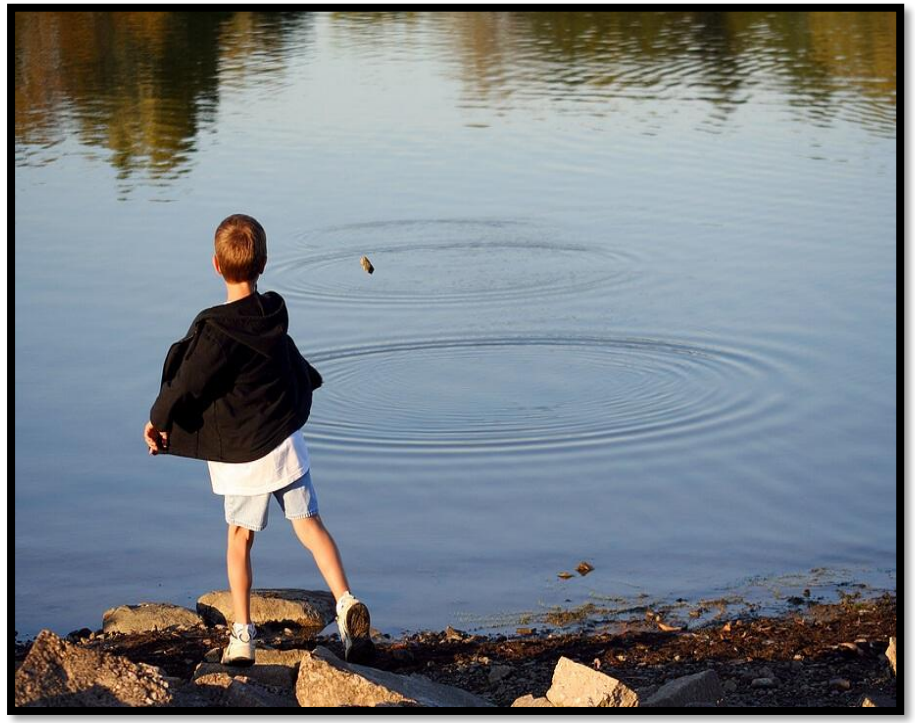


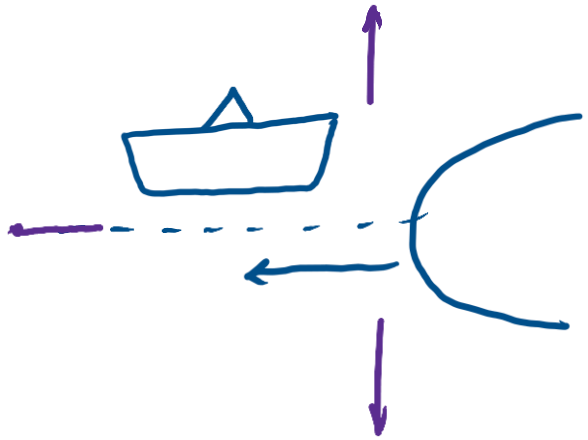
WHAT WILL WE STUDY ?

- Waves
- Wave Phenomena
- Terms associated with Vibrating Air Column / Strings
- Electromagnetic Waves

WAVES - Introduction

- A wave is a vibratory disturbance in a medium which carries energy from one point to another point without any actual movement of the medium.





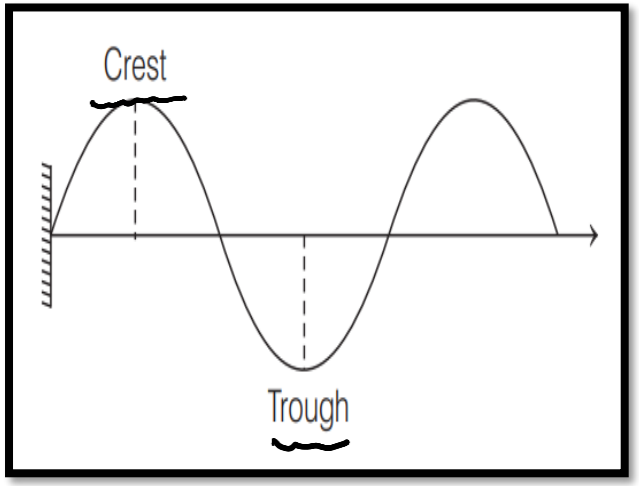
TYPES OF WAVES

1. Mechanical Waves : Those waves which require a material medium for their propagation, are called mechanical waves, e.g. sound waves, water waves etc.
2. Electromagnetic Waves : Those waves which do not require a material medium for their propagation, are called electromagnetic waves, e.g. light waves, radio waves etc.
3. Matter Waves : These waves are associated with electrons, protons and other fundamental particles.

NATURE

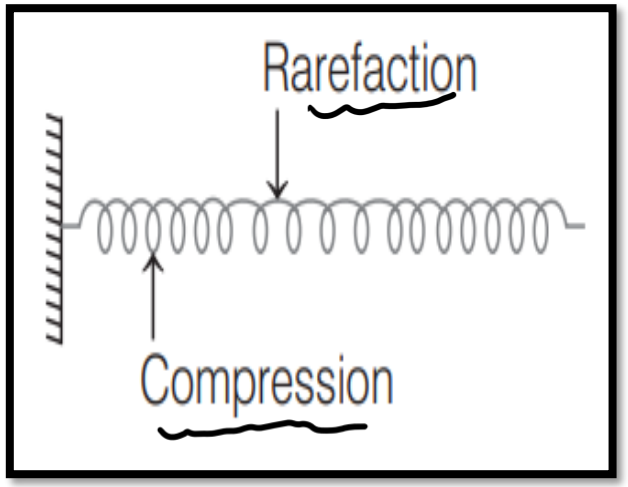
TRANSVERSE

- Particles of the medium vibrate at right angles to the direction of propagation of wave.
- These waves travel in the form of crests and troughs.



LONGITUDINAL

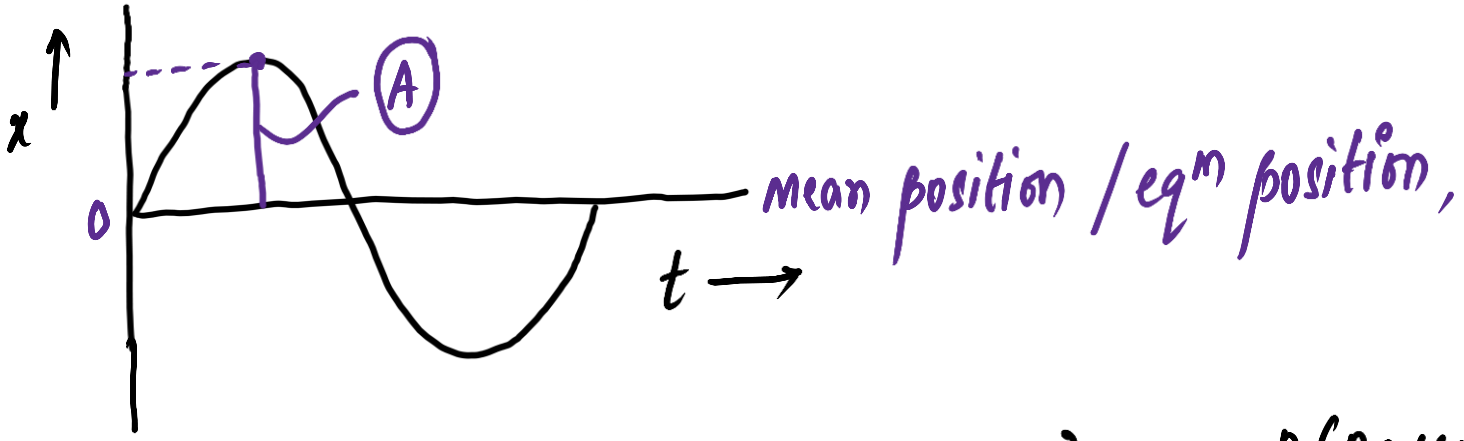
- Particles of the medium vibrate in the same direction in which wave is propagating.
- These waves travel in the form of compressions and rarefactions.

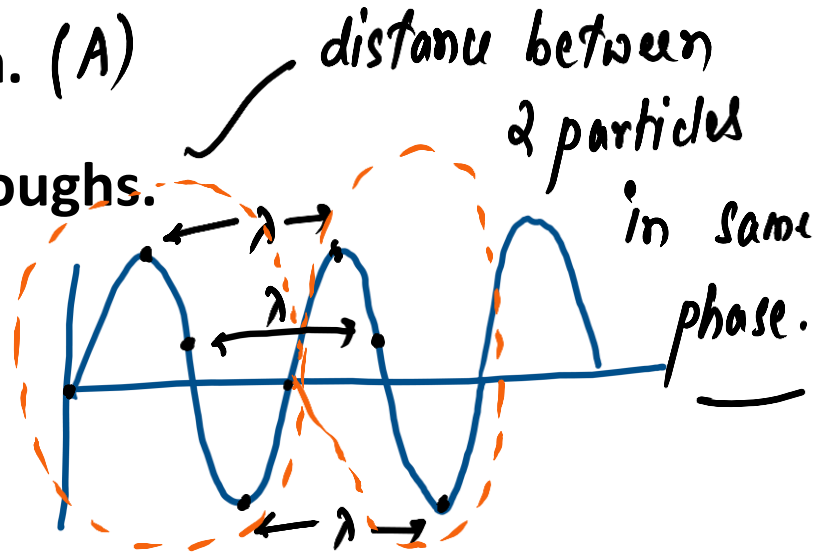


TERMS RELATED TO WAVE MOTION

1. **Amplitude :** Magnitude of maximum displacement of the particles from their mean or equilibrium position, as the wave passes through them. (A)

2. **Wavelength** : The distance between two crests or two troughs. (λ)





x → displacement (transverse) ; P (Pressure) or density (ρ) for longitudinal waves,

TERMS RELATED TO WAVE MOTION

3. **Time Period (T) :** Time taken to complete one vibration is called time period.

4. **Frequency :** The number of vibrations completed in one second.

$$\text{Frequency, } f = \frac{1}{\text{Time period } (T)}$$

$n / f = \frac{1}{T}$

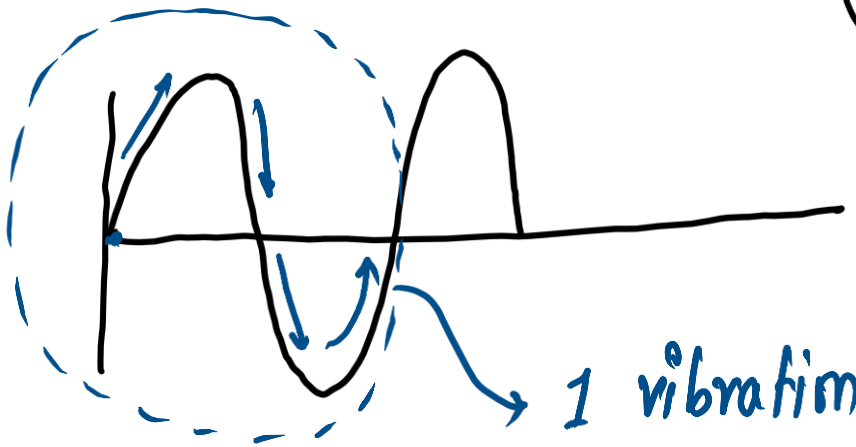
Unit = seconds (s)

Unit = $(\text{second})^{-1}$

$= s^{-1}$ or Hertz (Hz)

$$\text{Angular frequency, } \omega = \frac{2\pi}{T}$$

$\omega = 2\pi f$

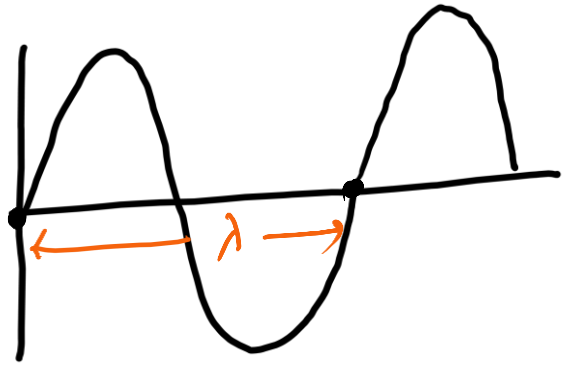


1 vibration / 1 oscillation

TERMS RELATED TO WAVE MOTION

5. **Velocity of Wave or Wave Velocity :** The distance travelled by a wave in one second is called velocity of the wave (v) .

$$v = \frac{\text{Distance}}{\text{Time}} = \frac{\lambda}{T} = \lambda\left(\frac{1}{T}\right) = \nu\lambda$$



$$\boxed{v = f\lambda}$$

TERMS RELATED TO WAVE MOTION

6. **Angular Frequency (ω) : The rate of change of phase with time is called angular frequency of the wave.**

$$\omega = \frac{2\pi}{T} = 2\pi n$$

CDS - PYQ – 2024 - II

A sound wave having frequency of 300 Hz is travelling in an unknown medium. Its wavelength is not known. It travels a distance equal to 150 times its wavelength in time t. The value of t is :

(a) 0·5 s

(b) 1 s

(c) 1·5 s

(d) 2 s

$$\lambda f = \frac{150\lambda}{t}$$

$$\frac{\lambda f}{\lambda} = \frac{150}{t}$$

$$f = \frac{150}{t}$$

$$t = \frac{150}{f} = \frac{150}{300\ Hz} = \frac{1}{2\ s^{-1}} = 0.5\ s$$

CDS - PYQ – 2024 - II

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(a) 0·5 s

(b) 1 s

(c) 1·5 s

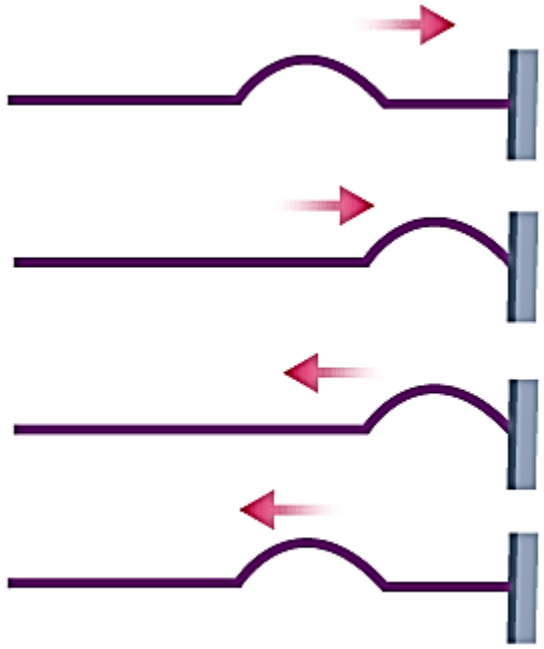
(d) 2 s

ANSWER : (a)

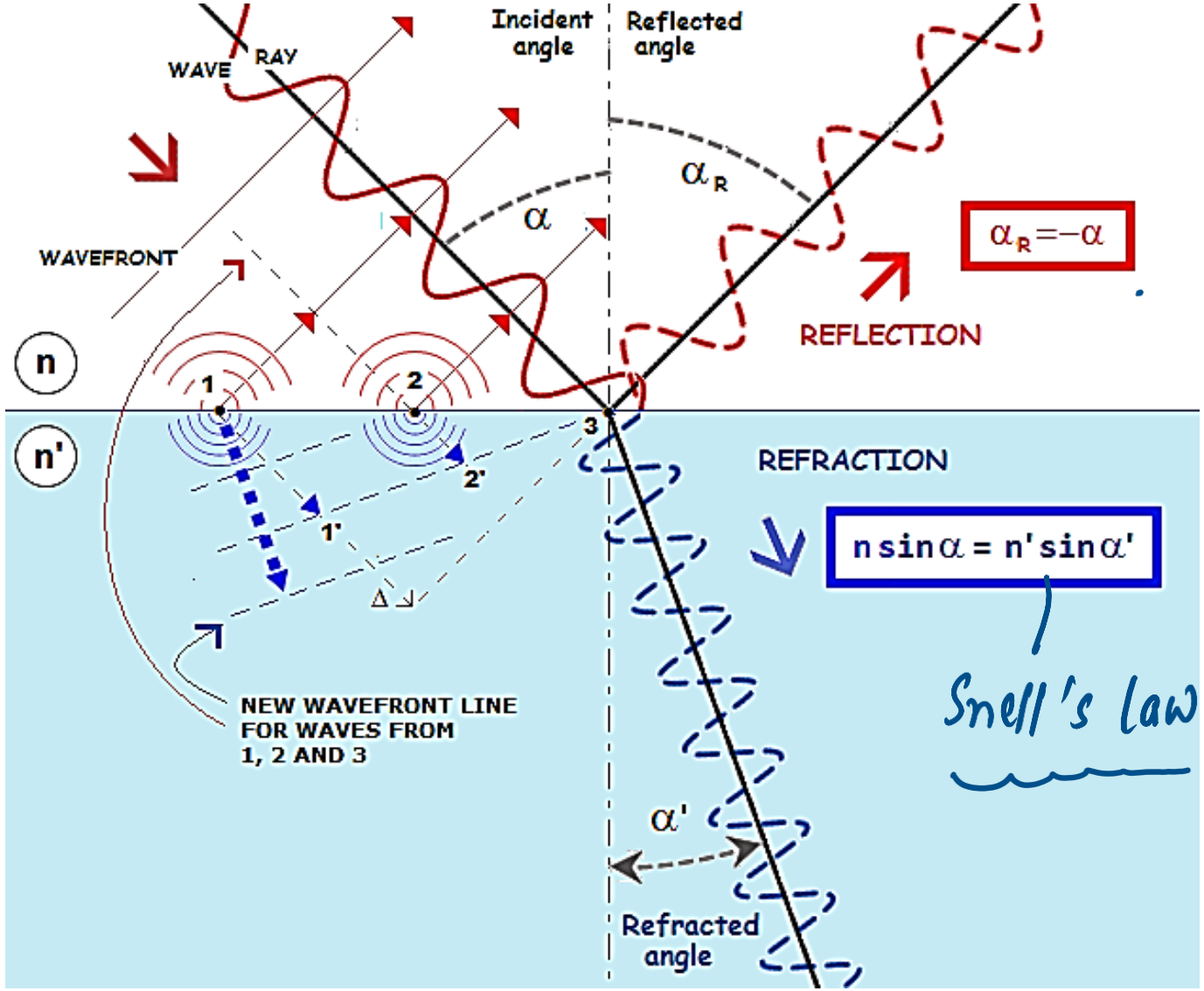
SOME WAVE PHENOMENA

Reflection : A wave encounters an obstacle and bounces back.

Refraction : A wave bends when it enters a medium through which it has a different speed.



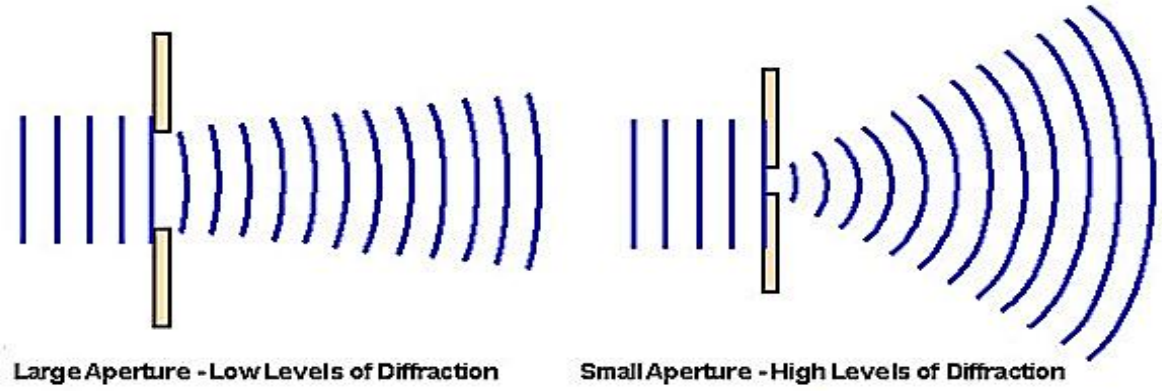
SOME WAVE PHENOMENA

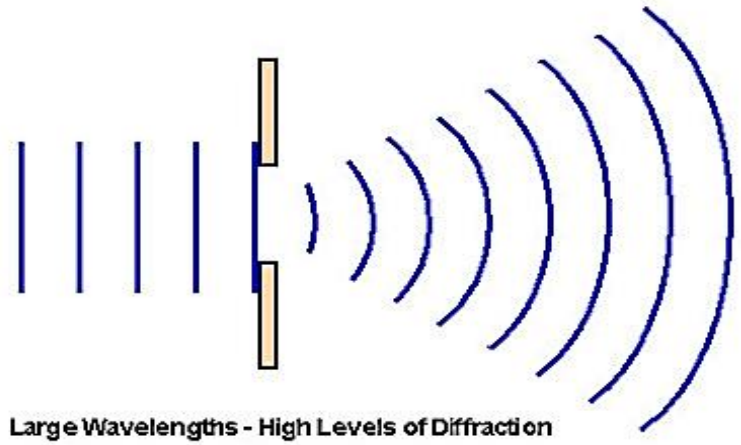


SOME WAVE PHENOMENA

Diffraction : Waves bend when they pass around small obstacles and spread out when they pass through small openings.

size of opening ~ 1.5 λ





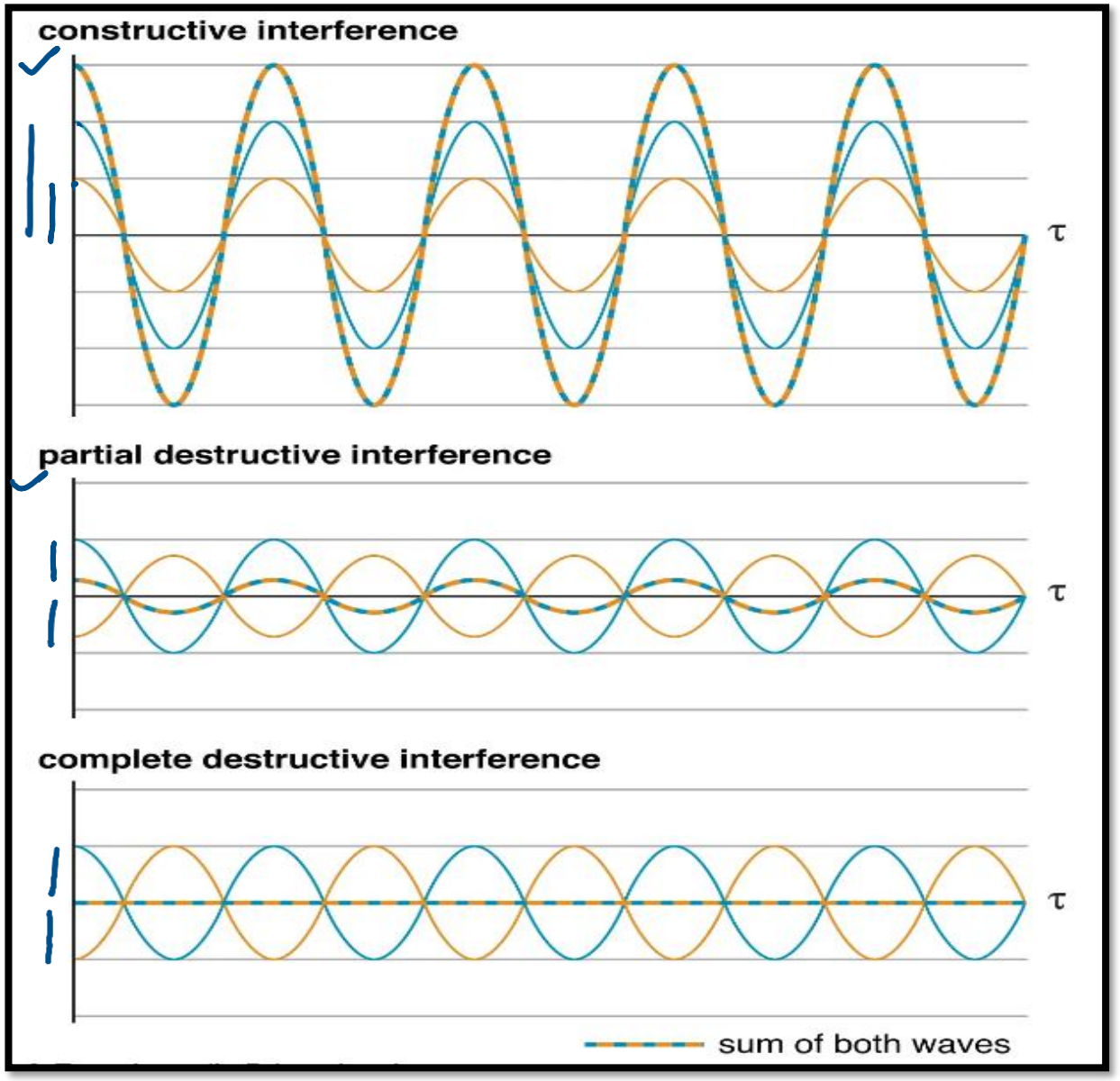
SOME WAVE PHENOMENA

Interference : In Interference, when two waves meet, they can interfere constructively, creating a wave with larger amplitude than the original waves, or destructively, creating a wave with a smaller (or even zero) amplitude.

The principle of superposition of waves states that when a number of waves travel through a medium simultaneously, the resultant displacement of any particle of the medium at any given time is equal to the algebaric sum of the displacement due to the individual waves.

$$y = y_1 + y_2 + y_3 + ... + y_n$$

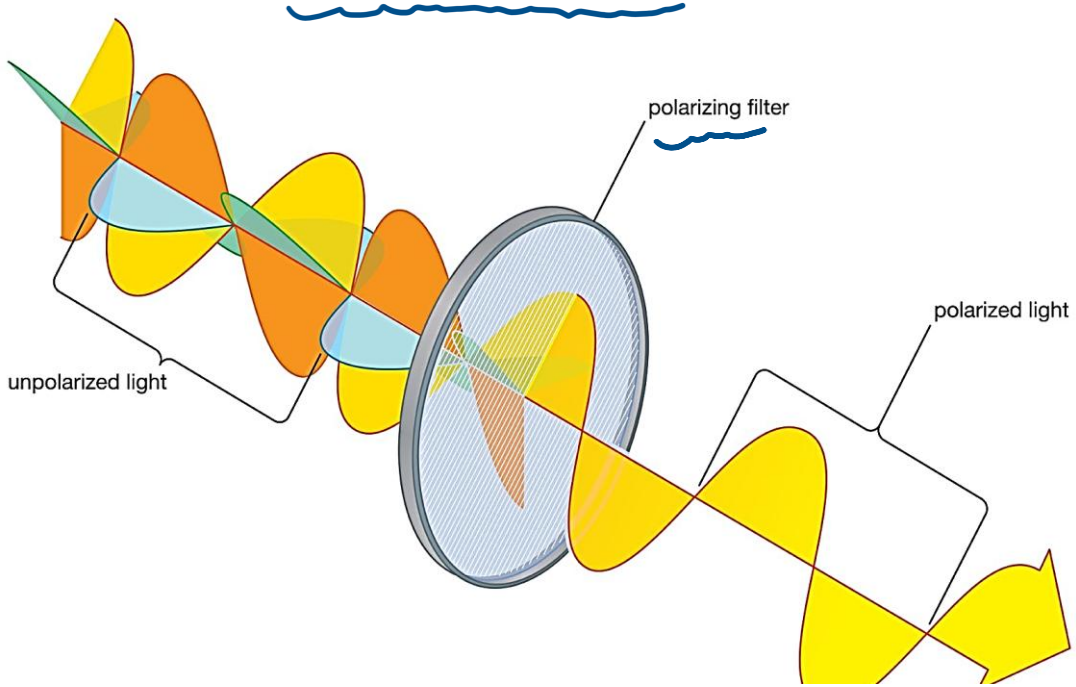
SOME WAVE PHENOMENA



SOME WAVE PHENOMENA

Polarisation : Making light (its Electric Field Vectors) , vibrate in a single direction.

(ONLY POSSIBLE IN TRANSVERSE WAVES)



Reflection
Refraction
Diffraction
Interference

} possible for both Longitudinal and transverse waves

TERMS RELATED TO VIBRATING AIR COLUMNS / STRINGS

1. **Fundamental Note :** It is the sound of lowest frequency produced in fundamental note of vibration of a system.
2. **Overtones :** Tones having frequencies greater than the fundamental note are called overtones.
3. **Harmonics :** When the frequencies of overtone are integral multiples of the fundamental, then they are known as harmonics. Thus, the note of lowest frequency n is called fundamental note or first harmonics. The note of frequency 2n is called second harmonic or first overtone.

BEATS

- Phenomenon based on Interference of waves.
- Beats arise when two waves having slightly different frequencies, v1 and v2 and comparable amplitudes, are superposed. The beat frequency is

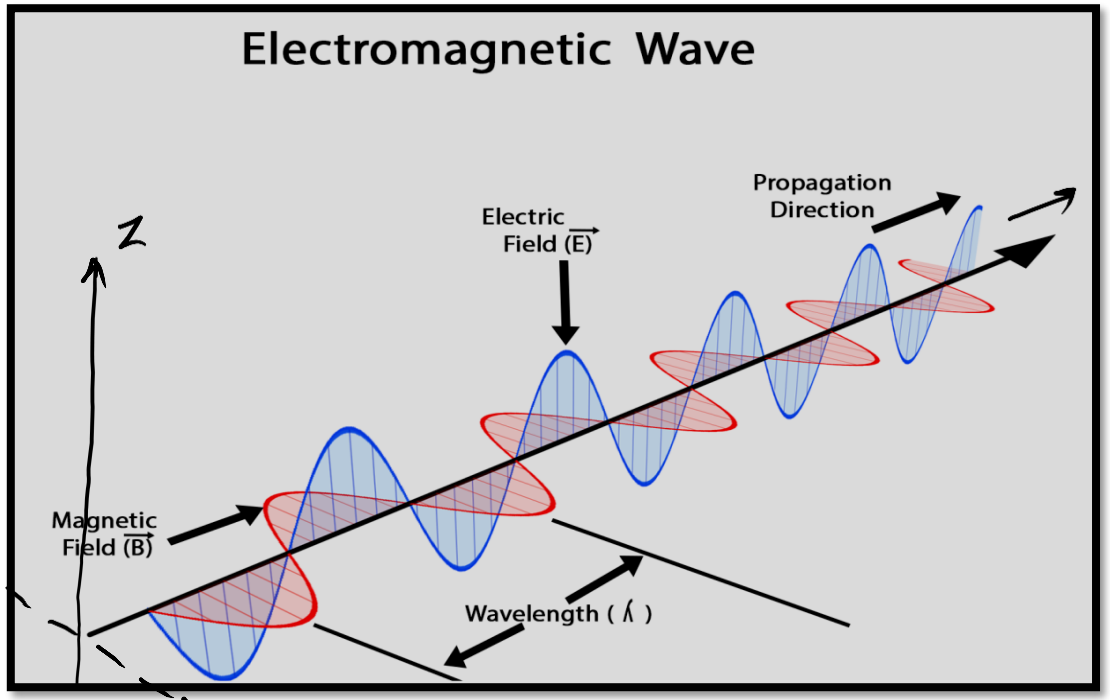
$$\nu_{beat} = \nu_1 - \nu_2$$

$(\nu_{beat} < 10)$

- <u>The intensity of resultant sound wave increases and decreases with time. This change in the intensity of sound, is called phenomenon of beats</u>. Resultant frequency is equal to the difference in frequencies of two sound sources.
- The difference of frequencies should not be more than 10.
- Artists use this phenomenon while tuning their instruments with each other. They go on tuning until their sensitive ears do not detect any beats.

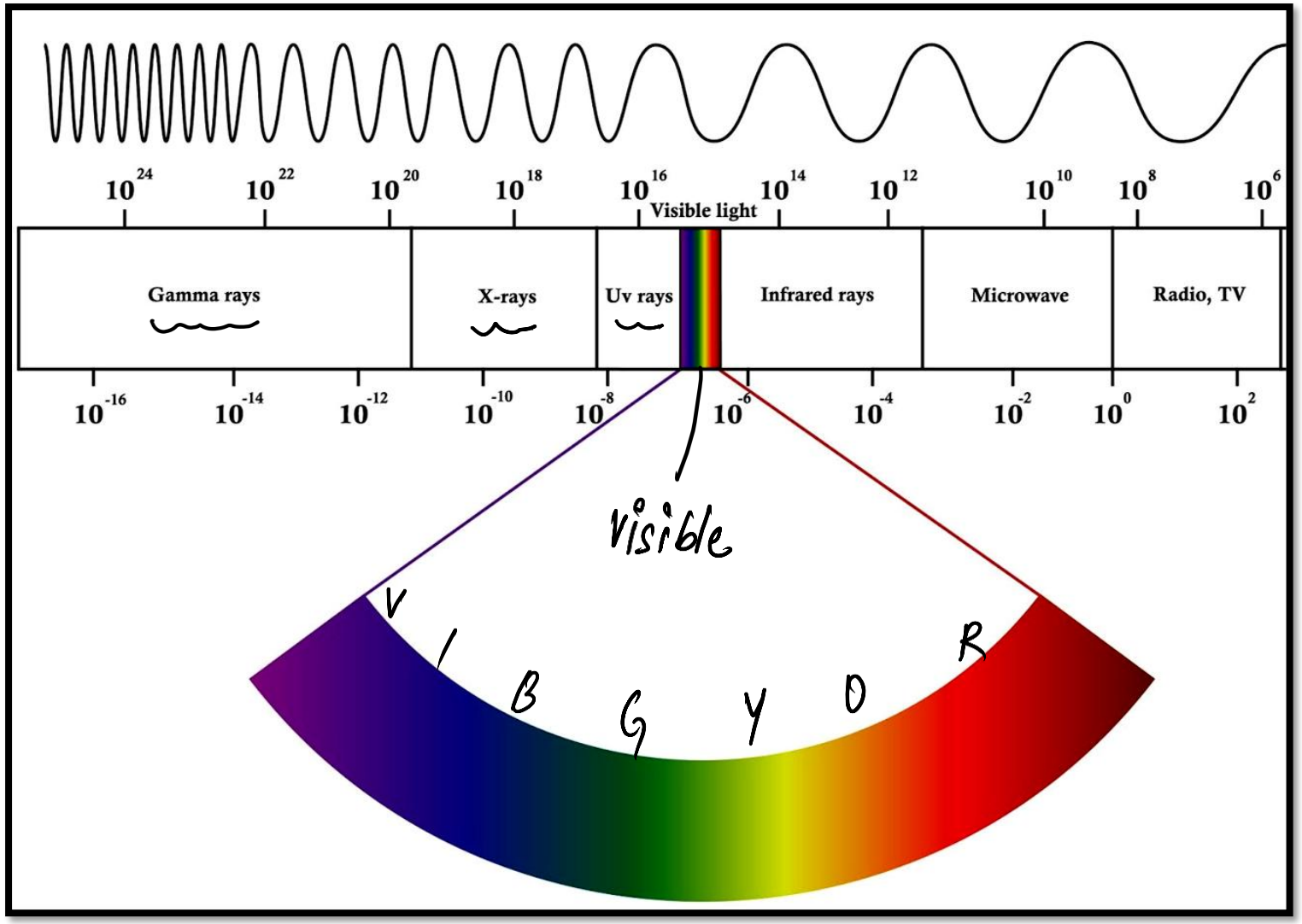
ELECTROMAGNETIC (EM) WAVES

1. They are transverse waves and do not require a material medium for propagation.
2. They travel at the speed of light which is 3×10^8 m/s, that is the speed of light.
3. They consist of two waves oscillating perpendicular to each other , and also perpendicular to the direction of propagation of light.



→ Elastic waves

ELECTROMAGNETIC SPECTRUM



G X U V I M R

⟶ increasing λ

⟵ decreasing frequency

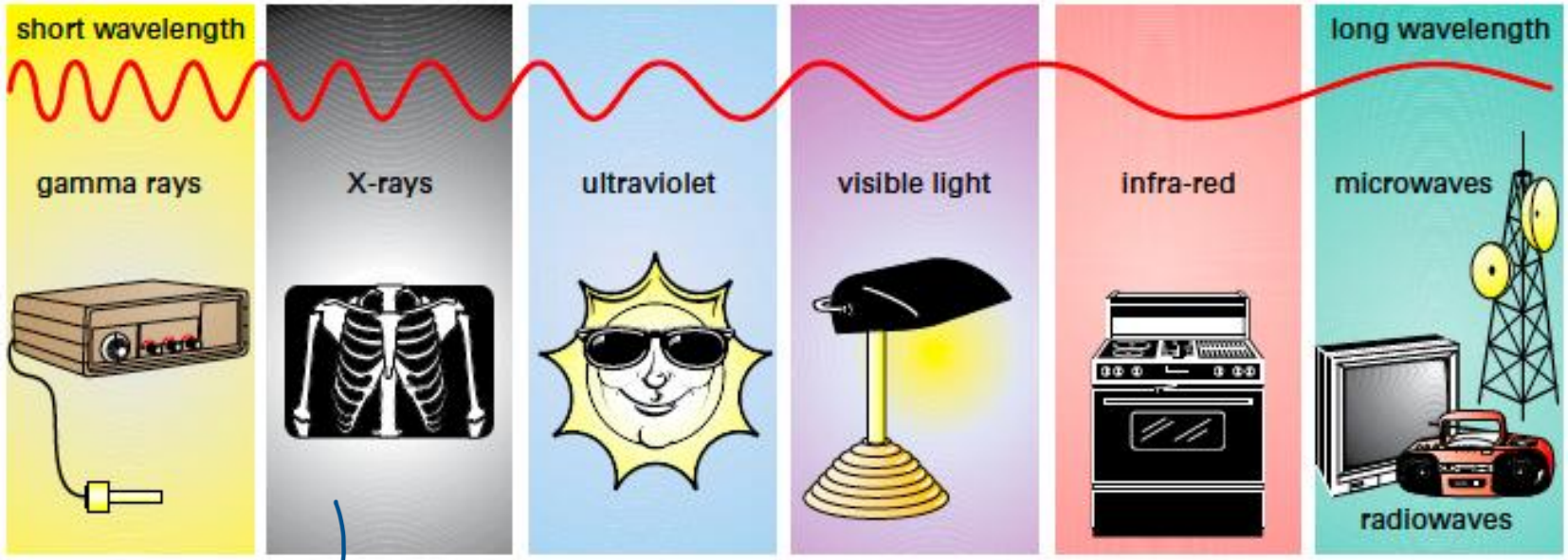
$V = 3 \times 10^8$ m/s (constant)

λf = constant

I - Infra-red

G - Gamma X - X-ray U - Ultra-violet V - Visible spectrum M - Microwave R - Radio

USES OF EM WAVES



Crystallography

USES OF EM WAVES

Gamma Rays : They are used in medicine to destroy cancer cells , studying nuclear structure.

X – Rays : Detecting faulty cracks, flaws and holes in metal products.
Studying crystal structure.
For detecting pearls in oyesters.

UV – Rays : Studying molecular structure .
Sterilizing surgical instrunments.
In the detection of forged documents, fingerprints.

Visible : Photosynthesis

USES OF EM WAVES

Infrared :
Infrared waves are **produced by hot bodies and molecules.**

Infrared waves are sometimes referred to as **heat waves.** This is because water molecules present in most materials readily absorb infrared waves (many other molecules, for example, CO_2 , NH_3 , also absorb infrared waves). After absorption, their thermal motion increases, that is, they heat up and heat their surroundings.

Infrared lamps are used in **physical therapy.**

USES OF EM WAVES

Infrared :

Infrared radiation also plays an important role in **maintaining the earth's warmth or average temperature through the greenhouse effect.** Incoming visible light (which passes relatively easily through the atmosphere) is absorbed by the earth's surface and re-radiated as infrared (longer wavelength) radiations. **This radiation is trapped by greenhouse gases such as carbon dioxide and water vapour.**

Infrared detectors are used in Earth satellites, both for military purposes and to observe growth of crops. Electronic devices (for example semiconductor light emitting diodes) also emit infrared and are widely used in the remote switches of household electronic systems such as TV sets, video recorders and hi-fi systems.

USES OF EM WAVES

Microwave : They are suitable for the radar (Radio detection and Ranging)
systems used in aircraft navigation.
Microwave ovens. (Heating up food containing water)

Radio : Used in radio and television communication systems.
Cellular phones use radio waves to transmit voice communication.

CDS - PYQ – 2024 - II

X-rays can be used to :

1. inspect welded joints between two metal parts of a machine.
2. study structure of crystals.

Select the answer using the code given below :

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

CDS - PYQ – 2024 - II

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1. inspect welded joints between two metal parts of a machine.
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Select the answer using the code given below :

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(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

ANSWER : (c)

NDA - PYQ – 2024 - I

Consider the two statements given below :

Statement-1 : Infrared waves are also called heat waves.

Statement-2 : Water molecules readily absorb infrared waves.

Select the correct answer using the code given below :

(a) Both the statements are individually true and Statement-2 is the correct explanation of Statement-1.

(b) Both the statements are individually true, but Statement-2 is ***not*** the correct explanation of Statement-1.

(c) Statement-1 is true, but Statement-2 is false.

(d) Statement-2 is true, but Statement-1 is false.

NDA - PYQ – 2024 - I

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Statement-1 : Infrared waves are also called heat waves.

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(c) Statement-1 is true, but Statement-2 is false.

(d) Statement-2 is true, but Statement-1 is false.

ANS : B

SUMMARY

- Waves and Terms Associated
- Wave Phenomena
- Terms Related to Vibrating Air Column / Strings
- Electromagnetic Spectrum

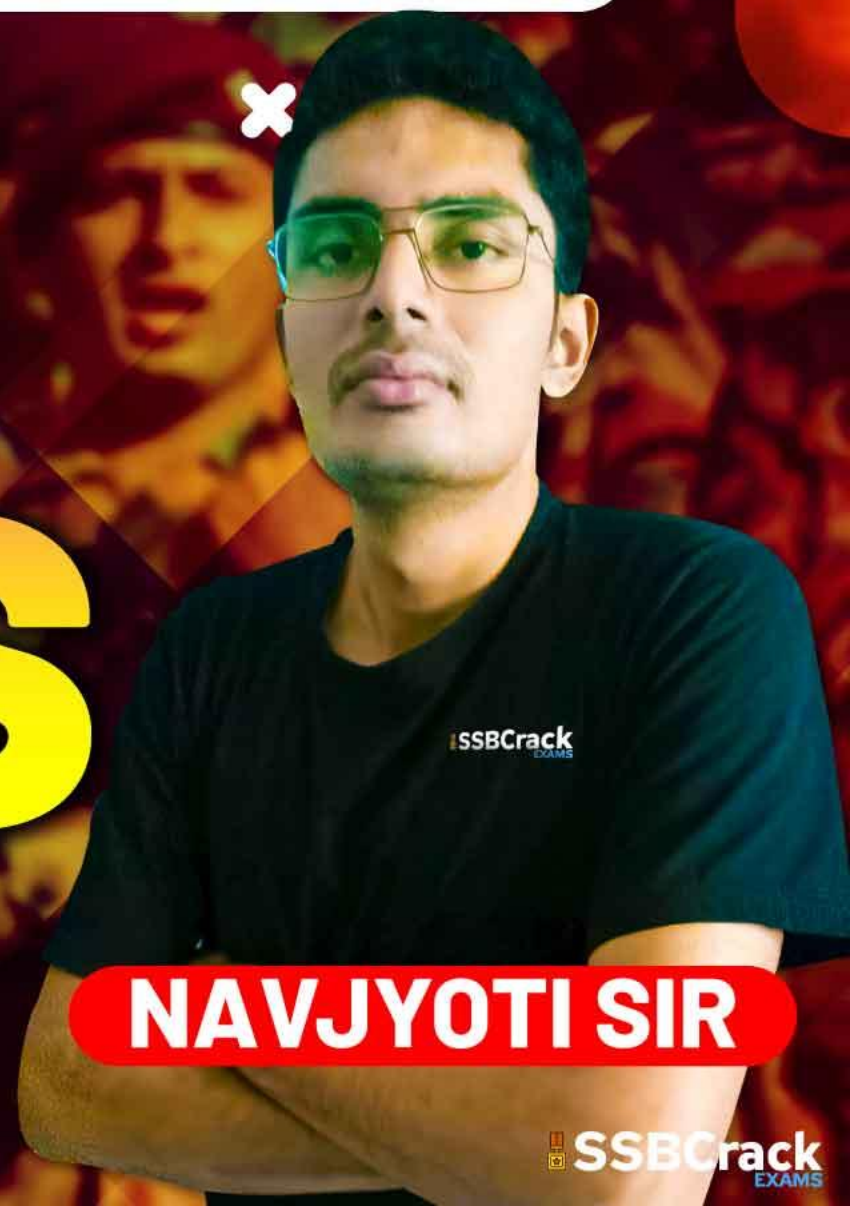
NDA-CDS 1 2025

GS

LIVE

PHYSICS

SOUND



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SSBCrack EXAMS