



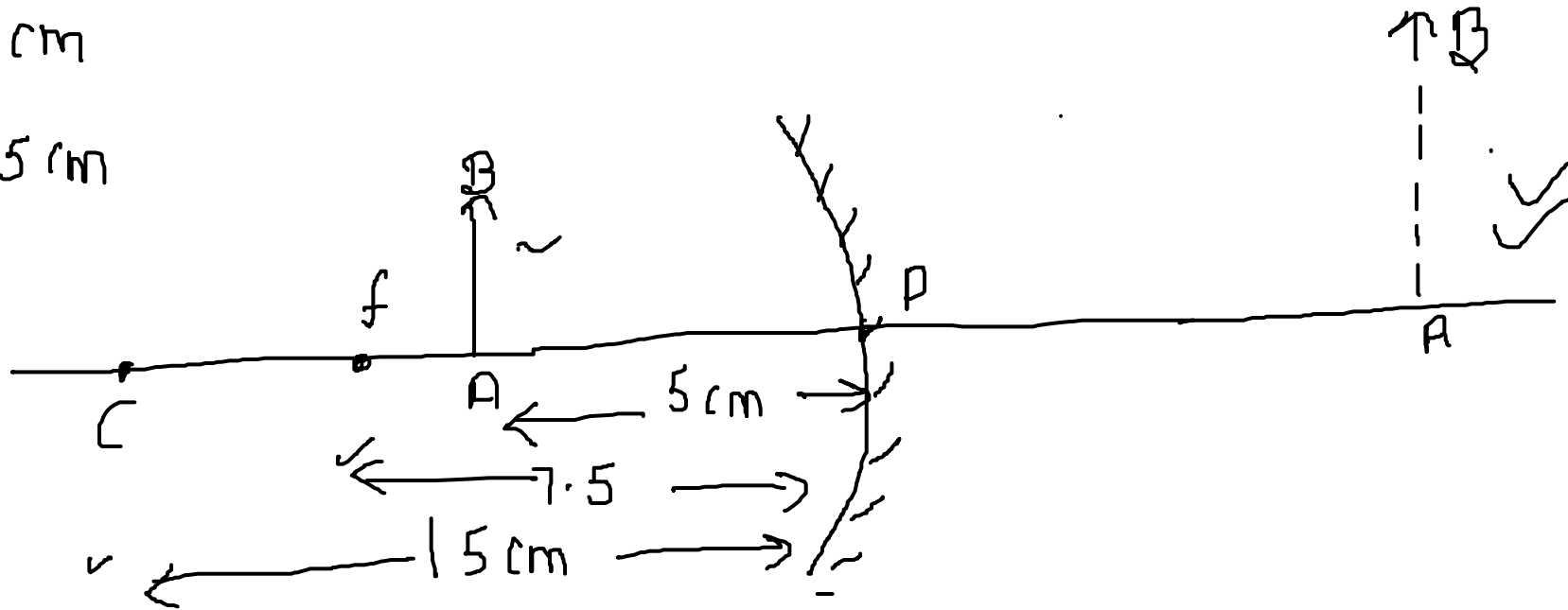
SAFALTA CLASS<sup>TM</sup>

An Initiative by **अमरउजाला**

- 1. An object is found to be 5 cm in front of a concave mirror of radius of curvature 15 cm. Determine the position, nature, and magnification of the image in each case.

$$R = 15 \text{ cm}$$

$$f = 7.5 \text{ cm}$$



# Refraction of Light

- Refraction is the change in the direction of a wave passing from one medium to another or from a gradual change in the medium.
- Laws of Refraction of Light:
- The incident ray refracted ray, and the normal to the interface of two media at the point of incidence all lie on the same plane.
- The ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant. This is also known as Snell's law of refraction.

$$\frac{\sin i}{\sin r} = \text{Constant}$$

# प्रकाश का अपवर्तन

- अपवर्तन एक माध्यम से दूसरे माध्यम से या माध्यम में क्रमिक परिवर्तन से एक लहर के गुजरने की दिशा में परिवर्तन है।
- प्रकाश के अपवर्तन के नियम:
  - आपतित किरण, ~~परावर्तित~~ अपवर्तित किरण, अभिलंब और आपतन बिंदु सभी एक ही तल में होते हैं।  
$$\left. \begin{array}{l} \text{आपतित} \\ \text{अपवर्तित} \end{array} \right\} \frac{\sin i}{\sin r} = \text{Constant}$$
  - अपवर्तन कोण के साइन के लिए घटना के कोण के साइन का अनुपात एक स्थिर है। इसे स्नेल के अपवर्तन के नियम के रूप में भी जाना जाता है।

Less Dense

Incident Ray

(Hava)  
Air

Glancing Angle  $i_g$

Angle of refraction

$$\left\{ \frac{\sin i}{\sin r} = c \Rightarrow \text{Snell's Law} \right.$$

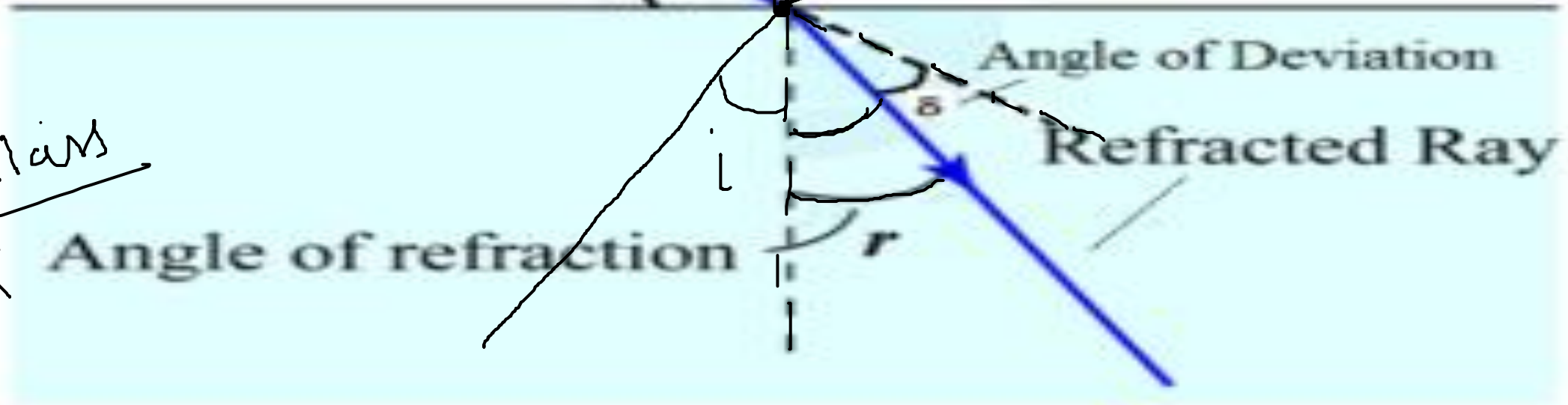
Normal

Angle  
of incident

Angle of Deviation

Refracted Ray

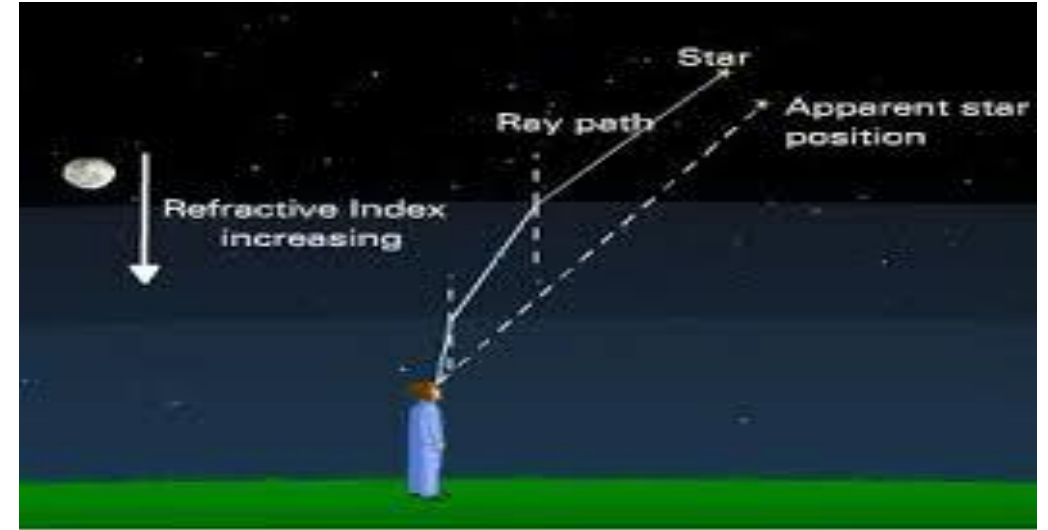
⇒ Glass  
शुद्ध



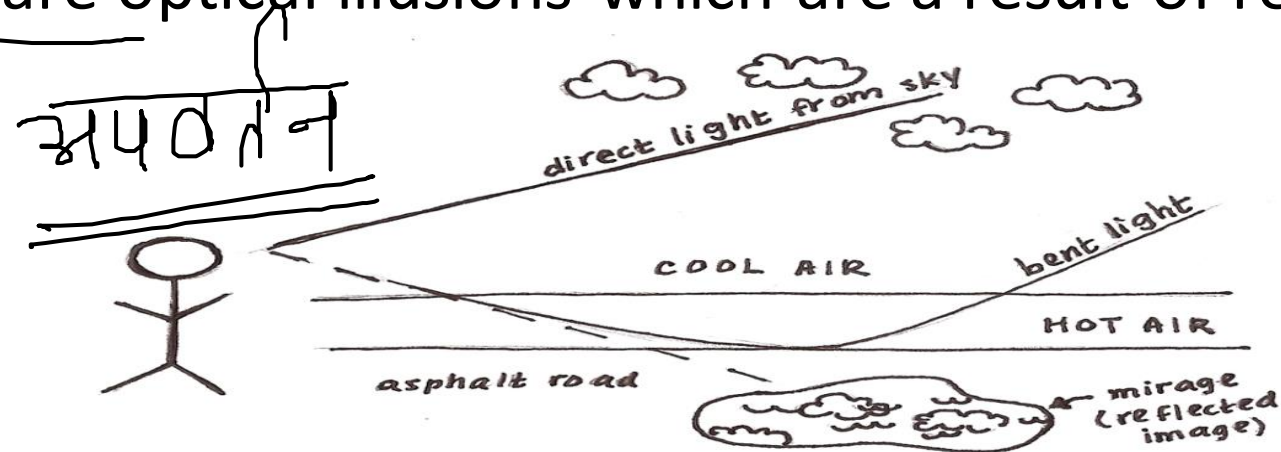
# • Effects of Refraction: ( ३८।६२०। )

- Twinkling of stars is due to refraction of light.

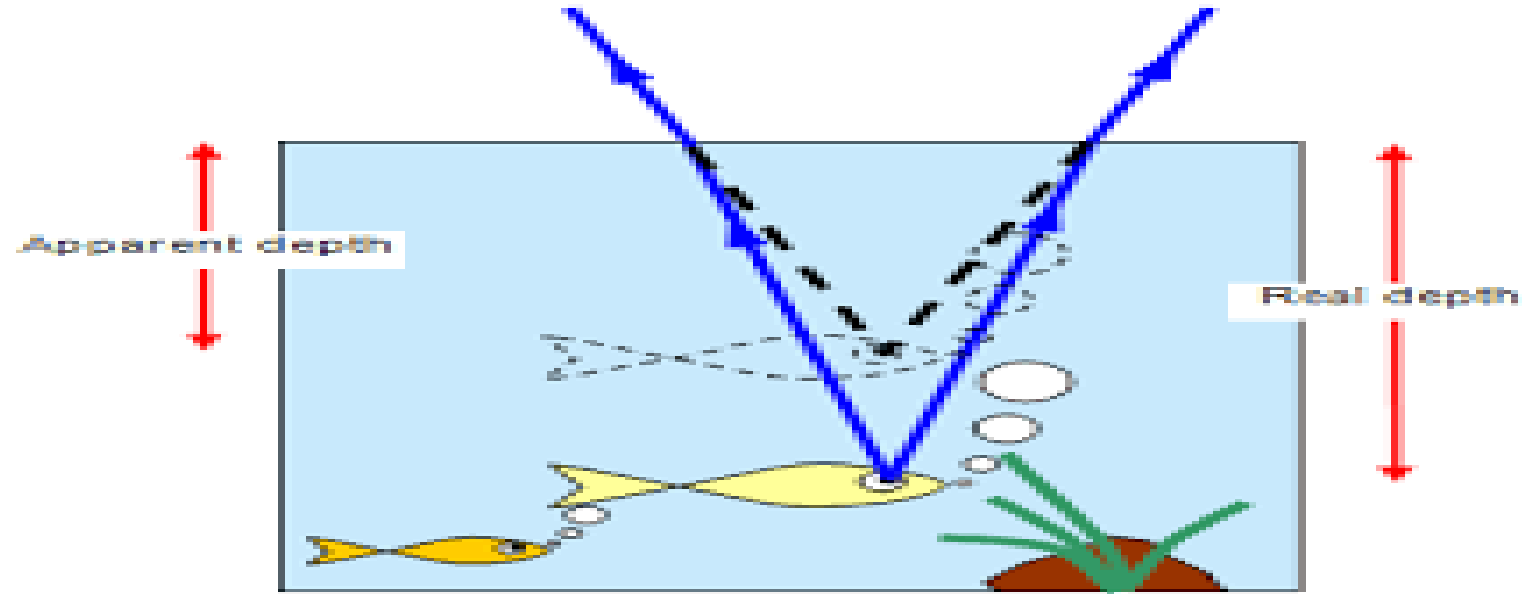
✓ अपवर्तन



- Mirage and looming are optical illusions which are a result of refraction of light.



- A swimming pool always looks shallower than it really is because the light coming from the bottom of the pool bends at the surface due to refraction of light.



- Formation of a rainbow is an example of refraction as the sun rays bend through the raindrops resulting in the rainbow.

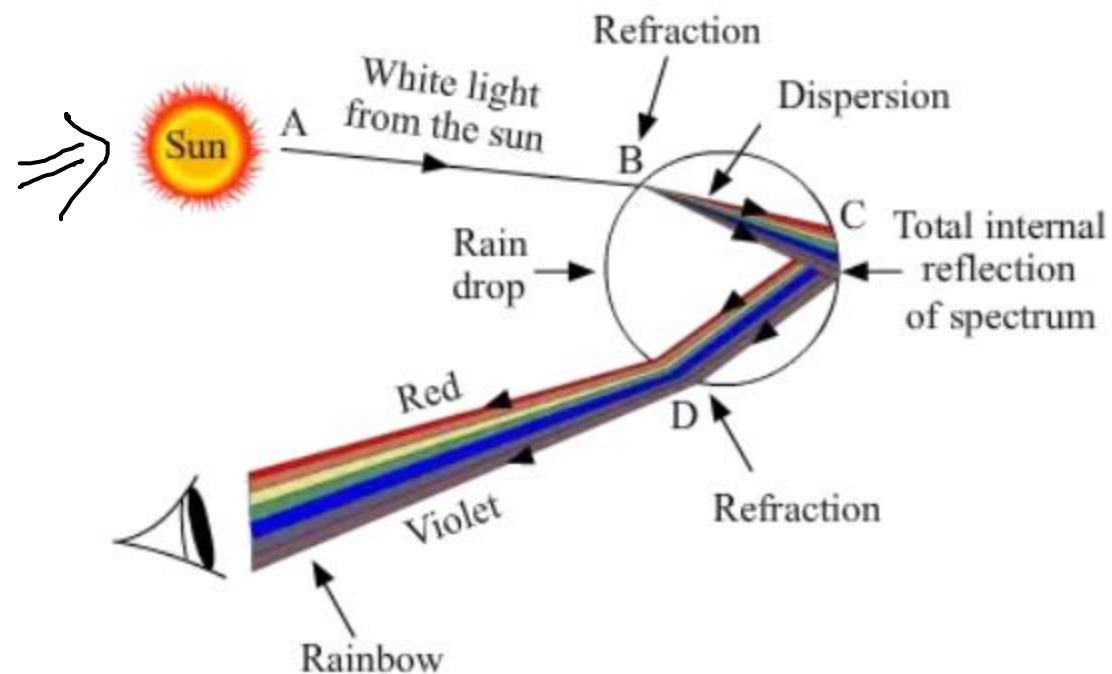
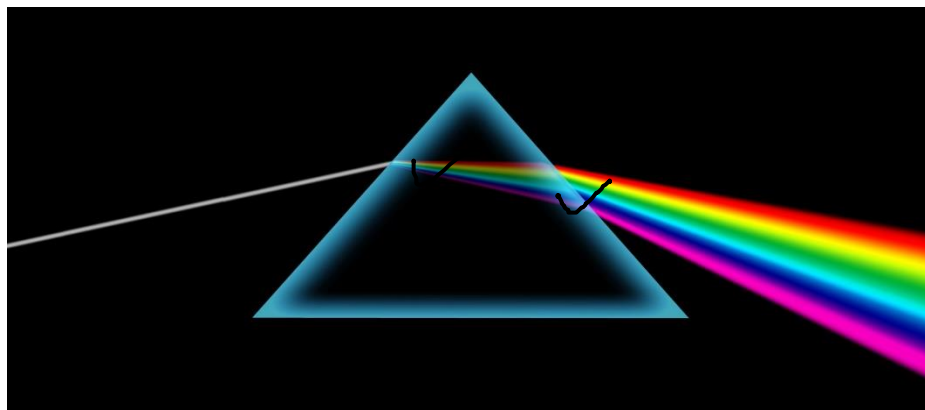
① Refraction અવકાશ

② Dispersion

③ Total internal Reflection.

- Prism is also an example of refraction.

અવકાશ, Dispersion ✓



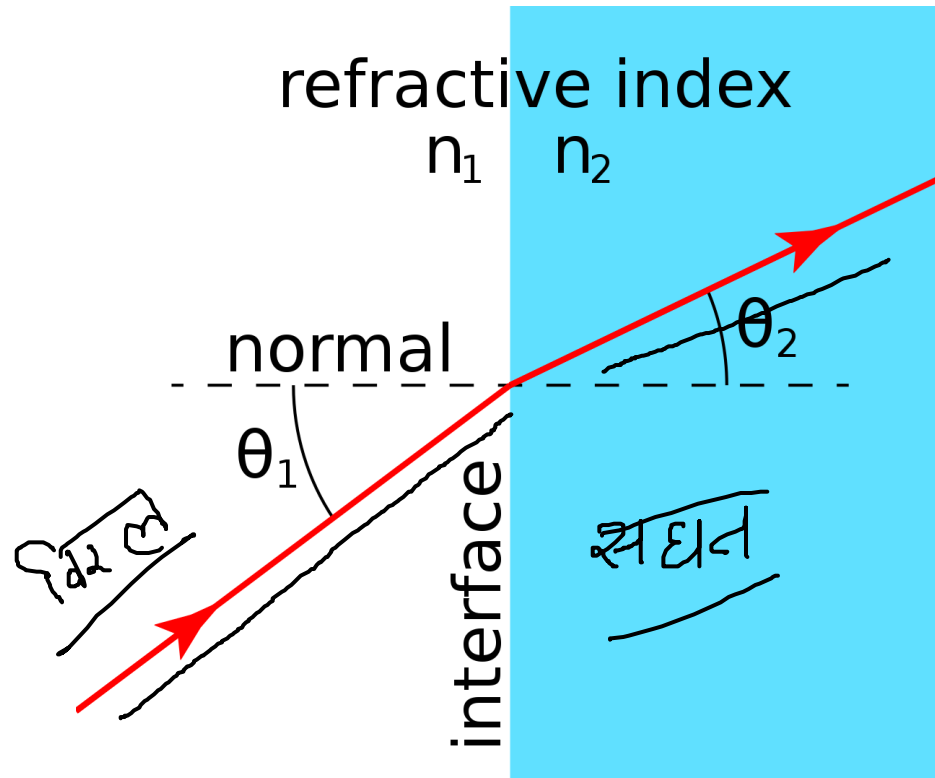


# • Refractive Index: (अपवर्तनांक)

- Refractive index also called the index of refraction describes how fast light travels through the material.

$$n = \frac{c}{v}$$

$\Rightarrow$  वायु में प्रकाश की चाल  
 $\Rightarrow$  माध्यम में चाल



<u>MATERIAL</u>	<u>INDEX OF REFRACTION (n)</u>
✓ Vacuum ✓ ବାକ୍ସୁମ୍	1.000
✓ Air	<u>1.00027</u>
Water ✓	1.333
Ice ✓	1.31
Glass ✓	1.5
Diamond	2.417



- What is the refractive index of the medium in which the speed of light is  $1.5 \times 10^8 \text{ m/s}$ ?

$$\underline{n = \frac{c}{v}} \rightarrow \frac{\text{वैकृत में चाल}}{\text{माध्यम में "}} = \frac{\cancel{3 \times 10^8}}{\cancel{1.5} \times 10^8}$$

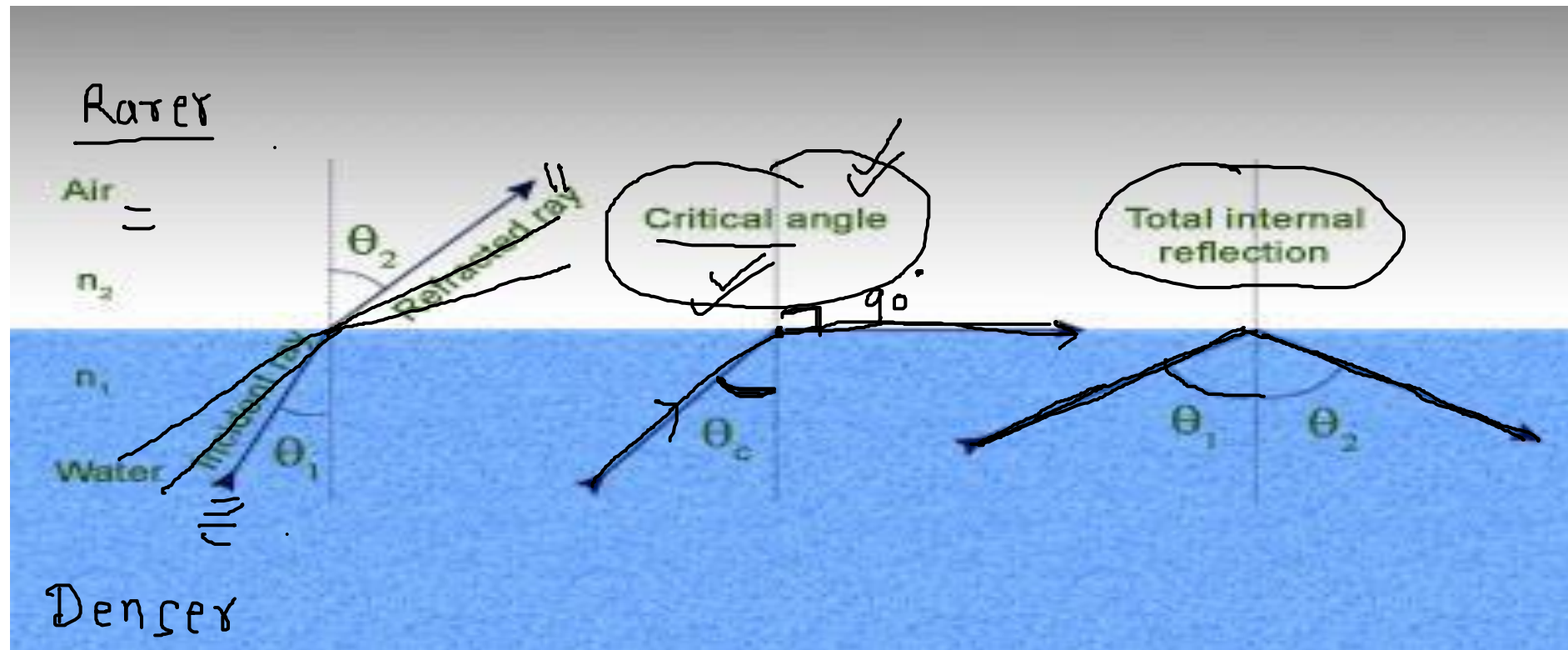
$$\boxed{n = 2}$$

- The speed of light in an unknown medium is  $1.76 \times 10^8 \text{ m/s}$ . Calculate the refractive index of the medium.

⇒ H.W.

# • Total Internal Reflection

- The phenomenon which occurs when the light rays travel from a more optically denser medium to a less optically denser medium.
- **पूर्ण आन्तरिक परावर्तन** (Total internal reflection) एक प्रकाशीय परिघटना है जिसमें प्रकाश की किरण किसी माध्यम के तल पर ऐसे कोण पर आपतित होती है कि उसका परावर्तन उसी माध्यम में हो जाता है।



# • Two Conditions of Total Internal Reflection

- The light ray moves from a more dense medium to less dense medium.

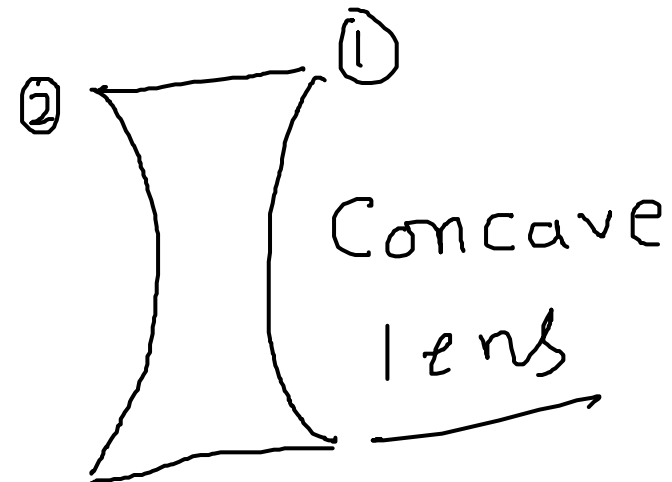
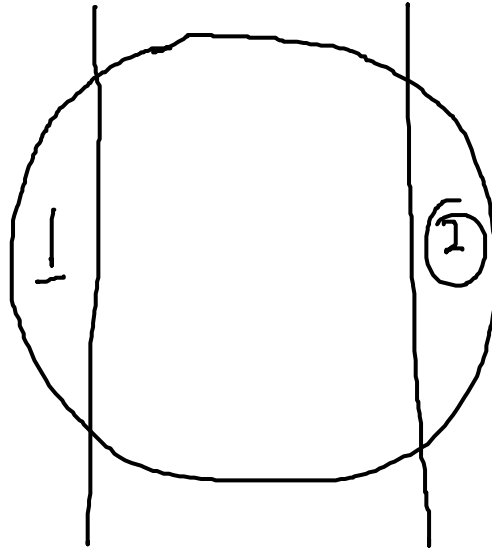
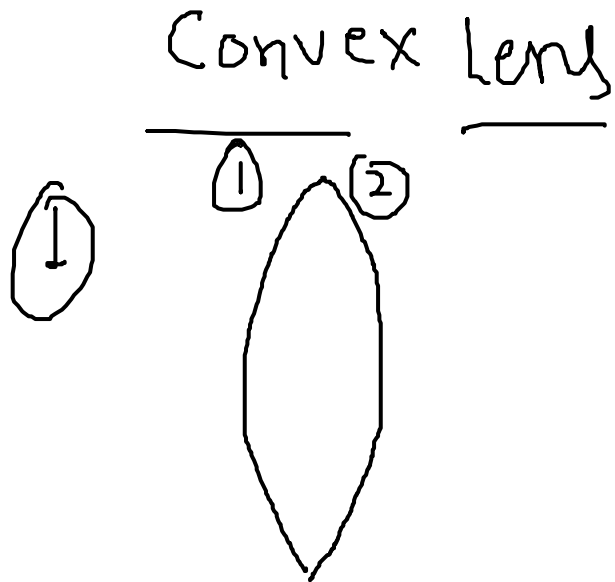
અદ્યન સે વિકલ

- The angle of incidence must be greater than the critical angle

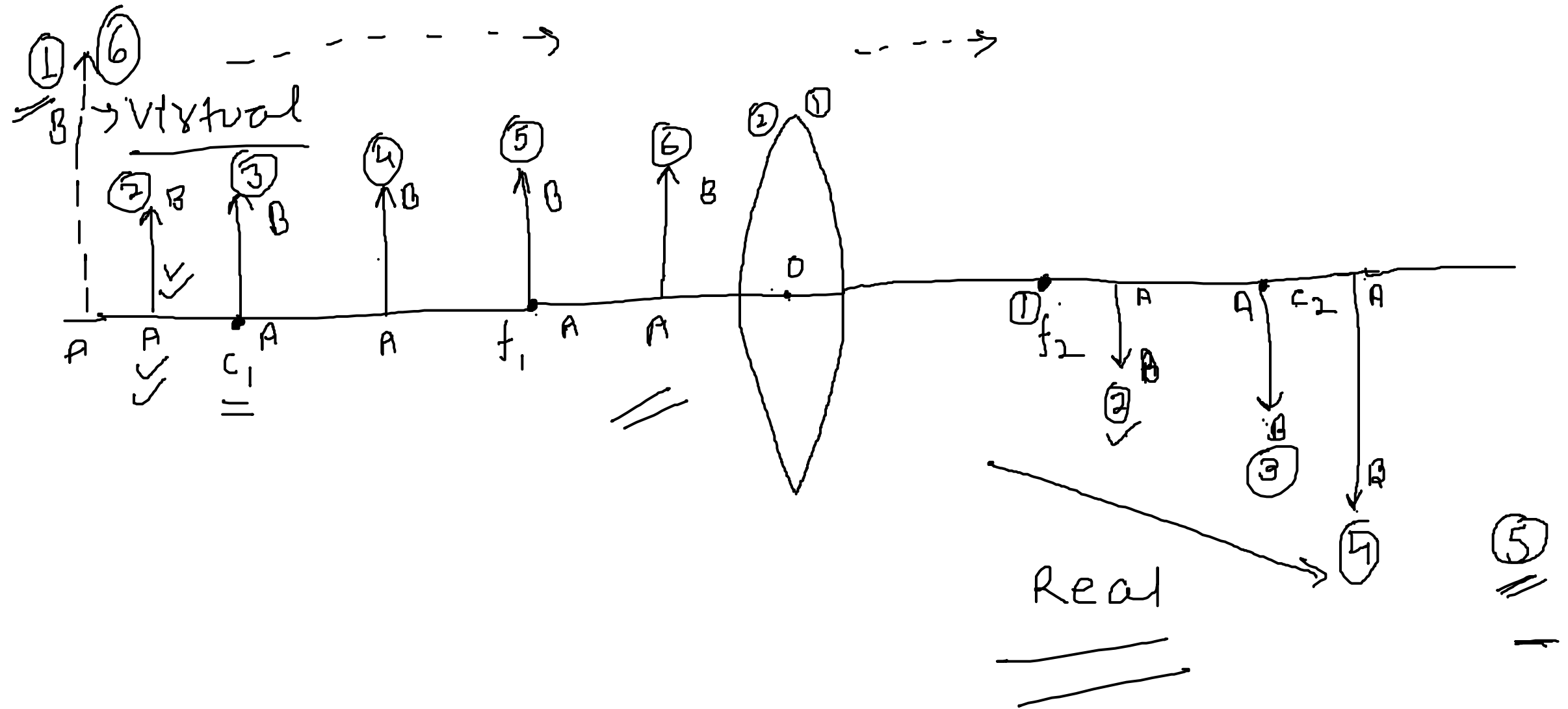
$$\underline{\angle i} > \underline{i_c} \quad \checkmark$$

TIR

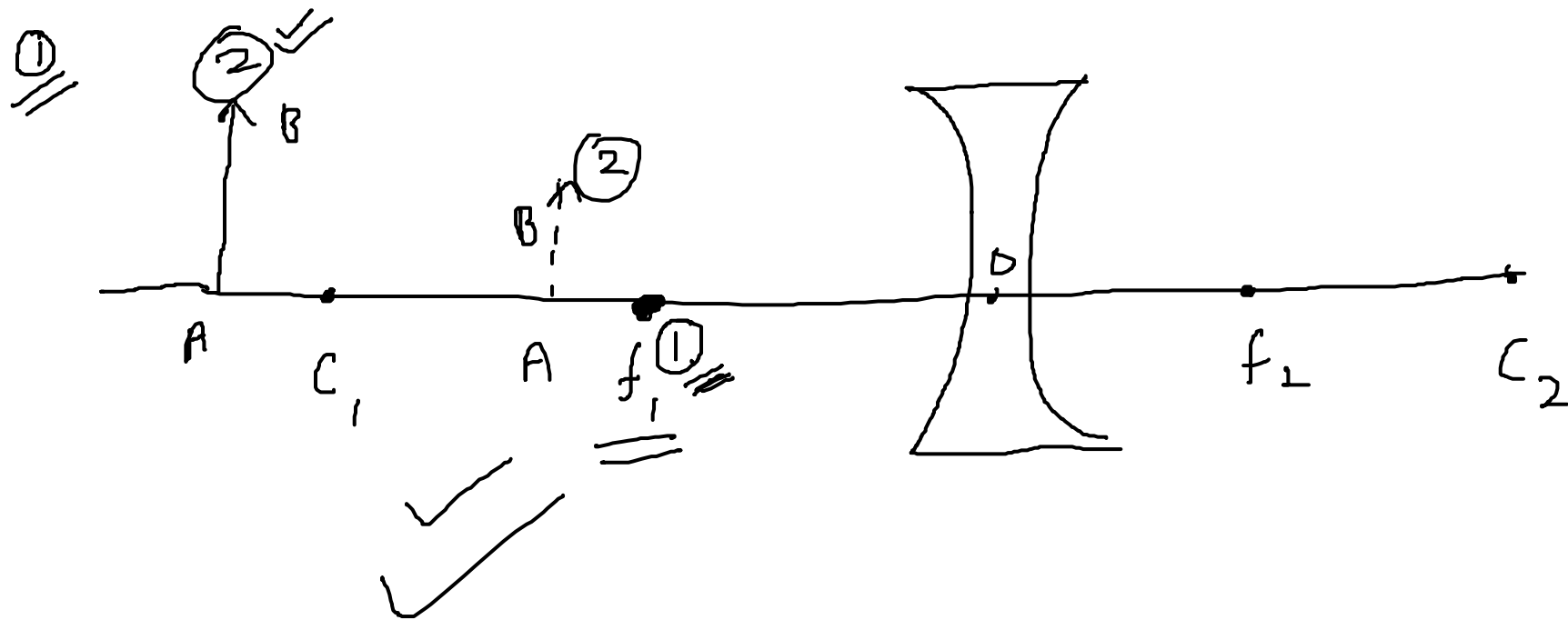
# Image Formation by Lens :



# CONVEX LENS : ✓ ⑥



# CONCAVE LENS :



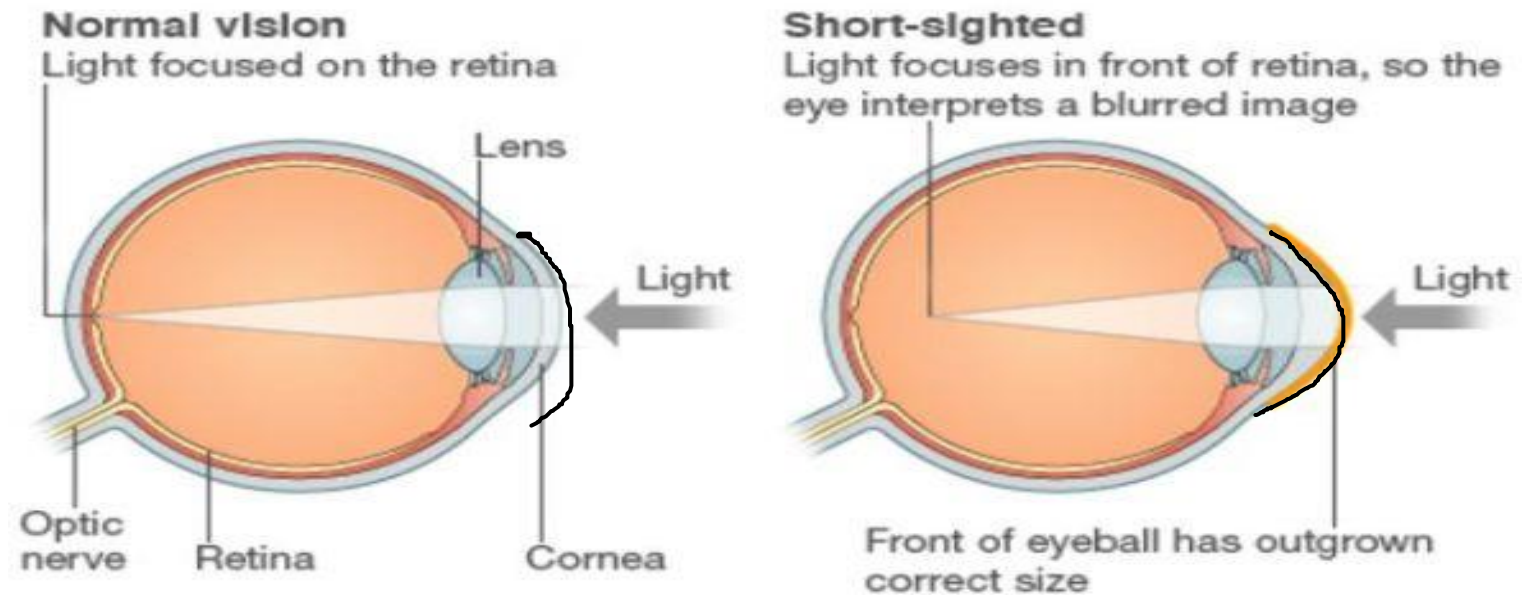


# Short Sightedness (or Myopia):

ନିମ୍ନ ଗୁଣି ଦୃଷ୍ଟି:-

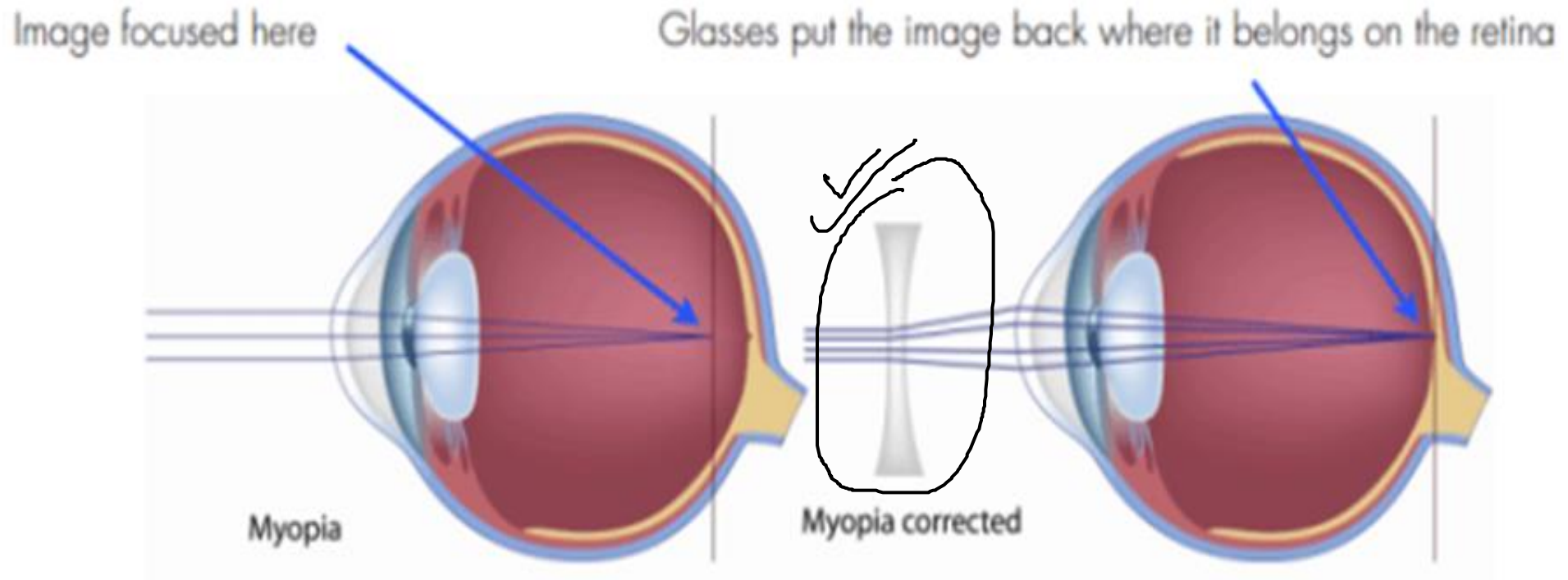
- This defect occurs if a person's eyeball is larger than the usual diameter.

What causes short-sightedness?



Source: Bupa

- To correct short-sighted vision, a diverging lens (concave lens) of suitable focal length is placed in front of the eyes.  
एक अदूरदर्शी दृष्टि को ठीक करने के लिए, आंखों के सामने उपयुक्त फोकल लंबाई का एक डायवर्जिंग लेंस (अवतल लेंस) रखा जाता है।



# Far Sightedness (or Hyperopia or Hypermetropia)

दूर दृष्टि दोष :-

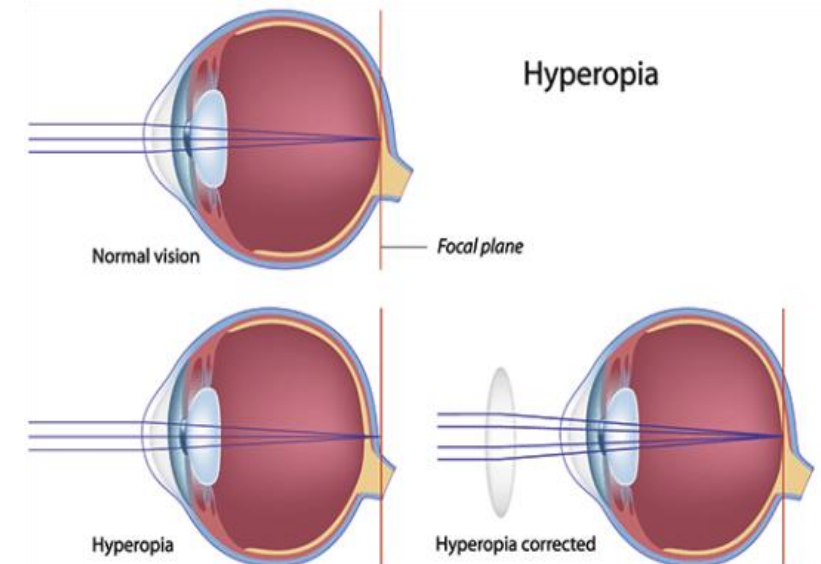
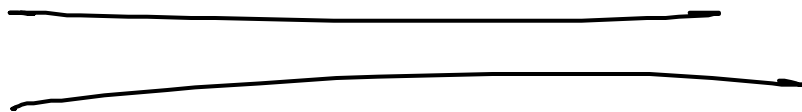
- This defect may occur if the diameter of person's eyeball is smaller than the usual or if the lens of the eye is unable to curve when ciliary muscle contract.

यह दोष तब हो सकता है जब किसी व्यक्ति के नेत्रगोलक का व्यास सामान्य से छोटा हो या यदि सिलिअरी मांसपेशी के अनुबंध में आंख का लेंस वक्र नहीं हो पाता है।


- A farsighted person has the normal far point but needs a converging lens in order to focus objects which are as close as 25 cm.

एक दूरदर्शी व्यक्ति के पास सामान्य दूर का बिंदु होता है, लेकिन वस्तुओं को केंद्रित करने के लिए एक अभिसरण लेंस की आवश्यकता होती है जो 25 सेमी के करीब होती हैं।

Concave Lens

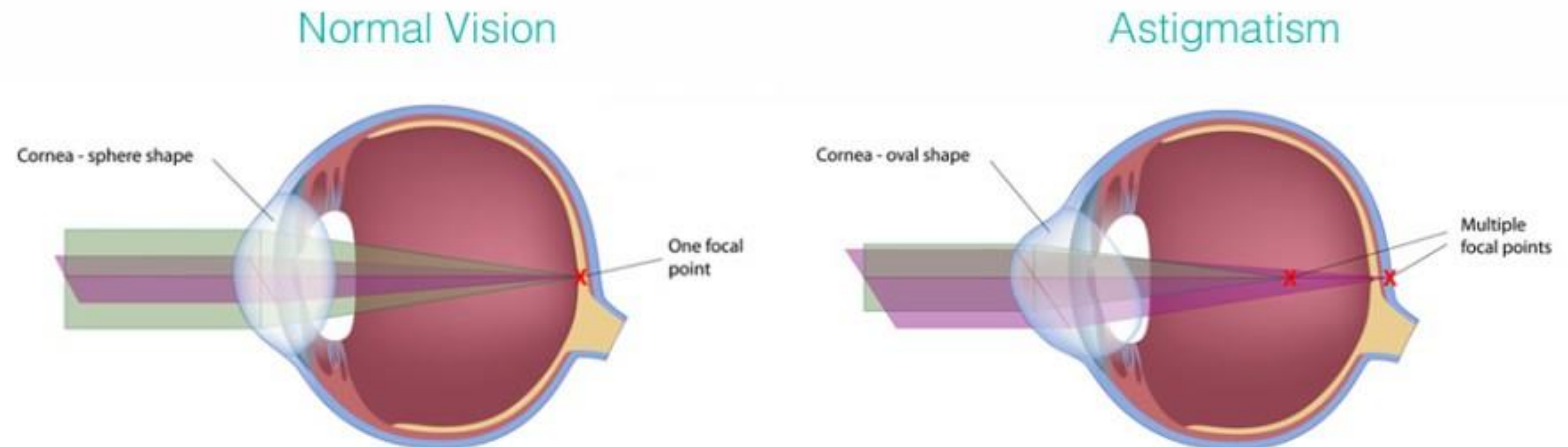


# Presbyopia

- This defect arises with aging. A person suffering from this defect can see neither nearby objects nor distant objects clearly/distinctly.
- This defect can be corrected by using bi-focal lenses  

- यह दोष उम्र बढ़ने के साथ उत्पन्न होता है। इस दोष से पीड़ित व्यक्ति न तो पास की वस्तुओं को देख सकता है और न ही दूर की वस्तुओं को स्पष्ट / स्पष्ट रूप से देख सकता है।
- द्वि-फोकल लेंस का उपयोग करके इस दोष को ठीक किया जा सकता है।

# Astigmatism

- A person suffering from this defect cannot simultaneously focus on both horizontal and vertical lines of wire gauze.
- This defect can be corrected by using cylindrical lenses.
- इस दोष से पीड़ित व्यक्ति एक साथ तार धंध की क्षैतिज और ऊर्ध्वाधर दोनों रेखाओं पर ध्यान केंद्रित नहीं कर सकता है।
- बेलनाकार लेंस का उपयोग करके इस दोष को ठीक किया जा सकता है।



# • Daily Life Examples of Scattering of Light ✓

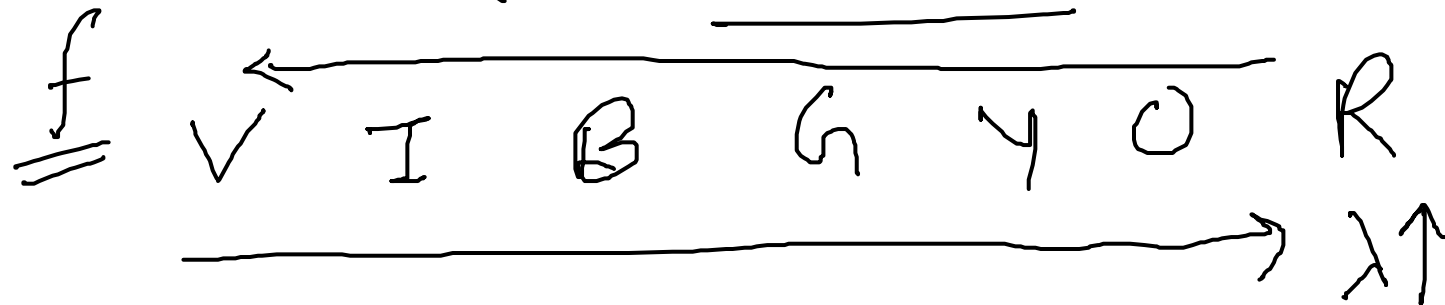
✓ 1. Blue color of sky. ✓✓

✓ 2. Red color of signals of danger. →  $\frac{750 \text{ nm}}{\lambda}$  ✓✓

✓ 3. Black color of sky in the absence of atmosphere

✓ 4. Red color of the time of sun rise and sun set.

✓ 5. The human eye is most sensitive to yellow color.



- The focal length of eye lens controlled by-

- (A) Iris
- (B) Cornea
- (C) Ciliary muscles ✓
- (D) Optic nerve

- A white light falls on a glass prism, the least deviated colour is –

- (A) Violet
- (B) Orange ✓
- (C) Red
- (D) Yellow

- Blue colour of sky is due to –
  - (A) dispersion of light
  - (B) scattering of light
  - (C) refraction of light
  - (D) reflection of light
- Rainbow is formed due to –
  - (A) reflection and dispersion of light through a water droplet
  - (B) Total internal reflection, refraction and dispersion of light through a water droplet
  - (C) only dispersion of light
  - (D) only refraction of light
- Power of accommodation (max. variation in power of eye lens) of a normal eye is about –
  - (A) 1D
  - (B) 2D
  - (C) 3D
  - (D) 4D

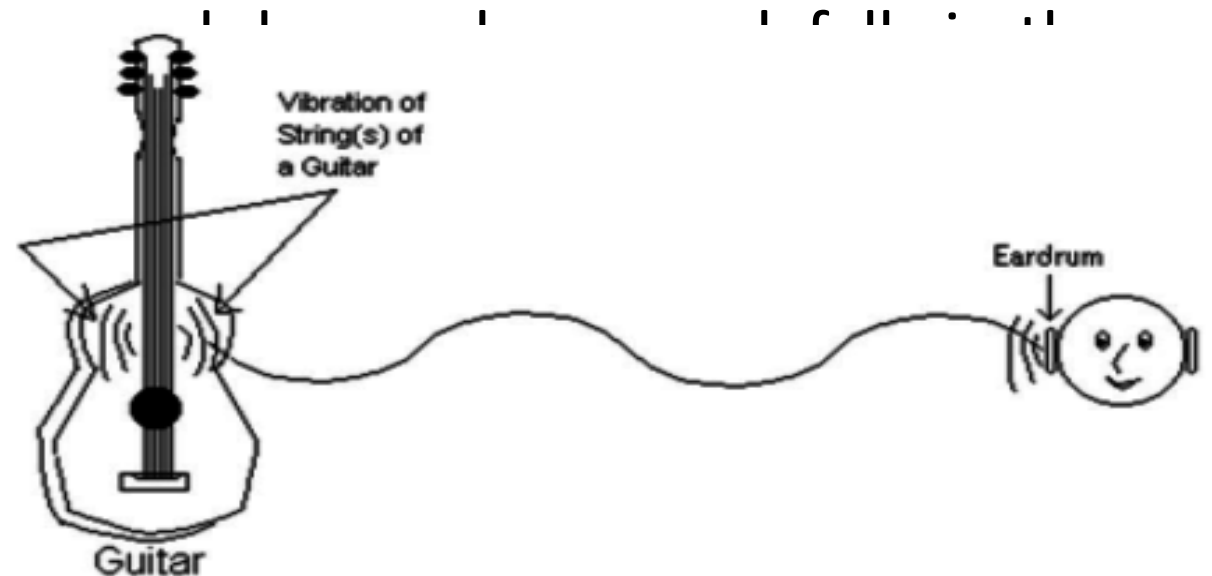


# • Introduction to waves

A wave is a disturbance in a medium which moves from one point to another and carries energy without a net movement of particles.

तरंग ऊर्जा या विक्षोभों के संचरण की वह विधि है जिसमें माध्यम के कण अपने स्थान पर ही कम्पन करते हैं तथा ऊर्जा एक स्थान से दूसरे स्थान तक आगे जाती है।"

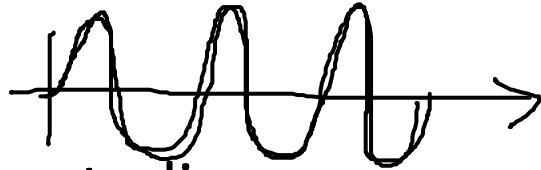
E.g: Rubber cork on the water that goes up and down while the wave moves forward creates a ripple.



## (i) Transverse Waves (अनुप्रस्थ तरंगे) :

Particle motion is perpendicular to the direction of wave motion. This type of wave is a mechanical wave.

यदि माध्यम के कण तरंग की गति की दिशा के लंबवत् दोलन करते हैं तो ऐसी तरंग को हम उसे अनुप्रस्थ तरंग कहते हैं।

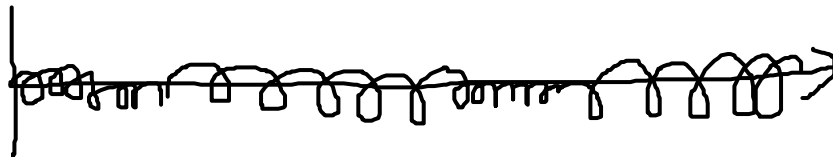


E.g: Light and Mexican wave in a stadium.

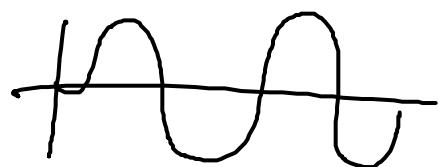
## (ii) Longitudinal waves (अनुदैर्घ्य तरंगे)

Particles travel parallel to the direction of wave motion, by means of successive compressions or elongations. This is also a mechanical wave.

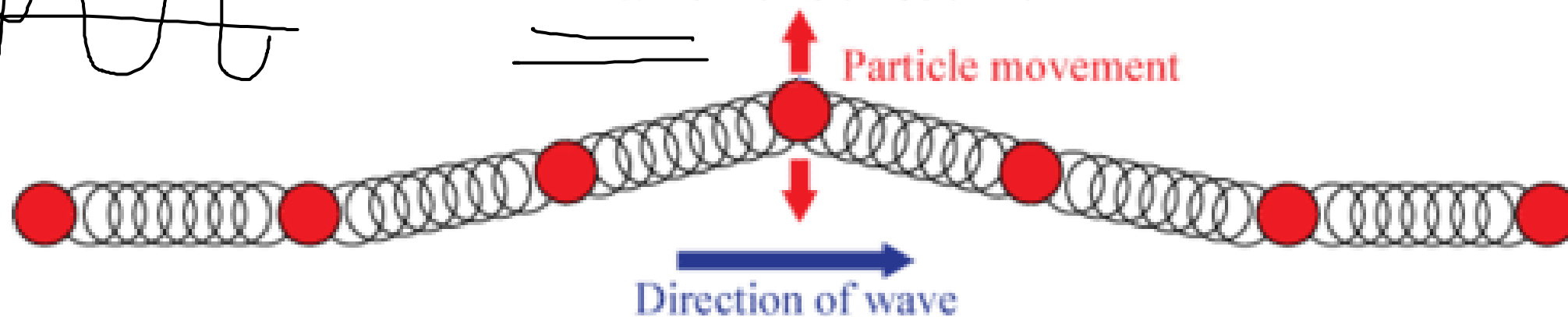
यदि माध्यम के कण तरंग की गति की दिशा के दिशा में ही दोलन करते हैं तो उसे अनुदैर्घ्य तरंग कहते हैं।



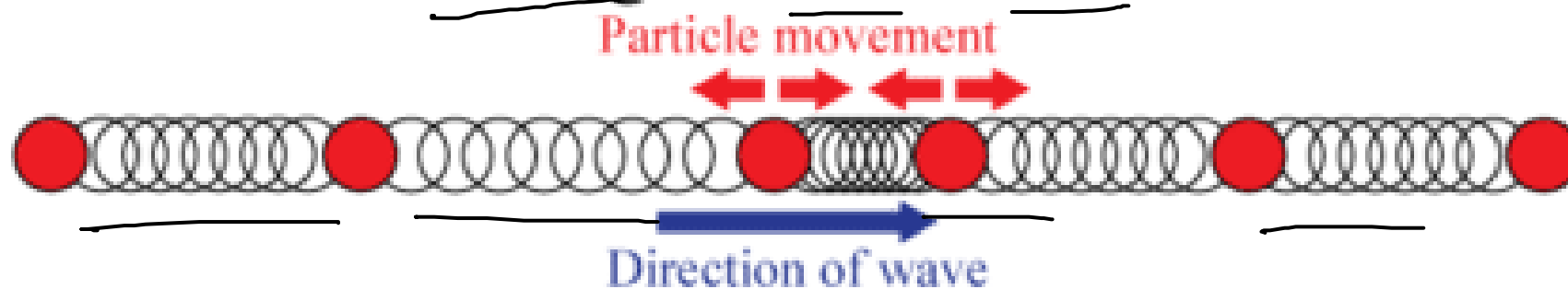
E.g: Sound waves in air.



## Transverse Wave



## Longitudinal Wave



# Sound (ध्वनि)

A vibration that propagates as an audible wave of pressure, through a medium such as a gas, liquid or solid.

ध्वनि तरंगों की प्रकृति अनुदैर्घ्य यांत्रिक होती है। इसका अर्थ यह है कि ध्वनि के

संचरण के लिए किसी माध्यम (होम द्रव गैस) की आवश्यकता होती है।



- **Propagation Of Sound**

Sound Needs A Medium To Travel

Sound Waves Are Longitudinal Waves

Speed Of Sound In Different Media

- **Reflection Of Sound ध्वनि का परावर्तन**

Echo

Reverberation

- **Wavelength**

The distance between two successive crests or troughs (or) successive compressions and rarefactions is called as wavelength ( $\lambda$ ). The SI unit of wavelength is meter (m).

जब कोई तरंग कम्पन्न या दोलन करती है तो एक दोलन या कम्पन्न होने में जितनी दूरी कण तय करता है उस दूरी को तरंग दैर्घ्य कहते हैं।  
या एक दोलन में कण द्वारा तय की गयी दूरी को तरंग दैर्घ्य कहते हैं।

- **Time period**

Time taken by two consecutive compressions or rarefactions to cross a fixed point is called a Time period (T). The SI unit of time in seconds (s).

एक निश्चित बिंदु को पार करने के लिए लगातार दो संकोचन या विरल द्वारा लिए गए समय को

समयावधि (T) कहा जाता है। सेकंड समय की SI इकाई

- **Amplitude**

The magnitude of disturbance in a medium on either side of the mean value is called an amplitude (A).

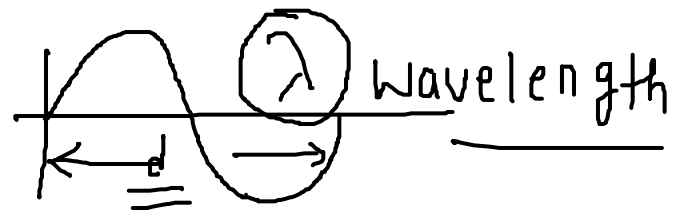
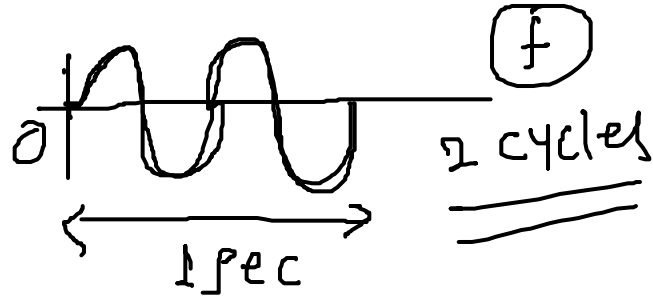
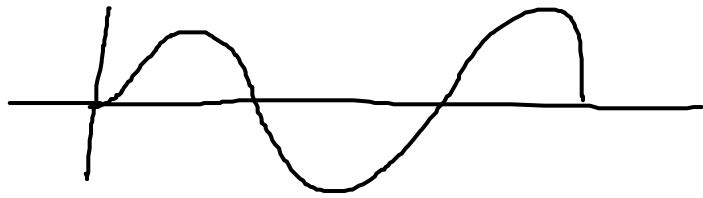
- **Frequency**

The number of compressions or rarefactions per unit time is called frequency (**v**). The SI unit of frequency is Hertz. The SI unit is Hertz (s<sup>-1</sup>).

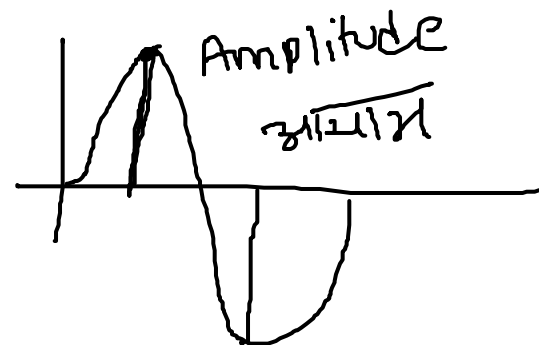
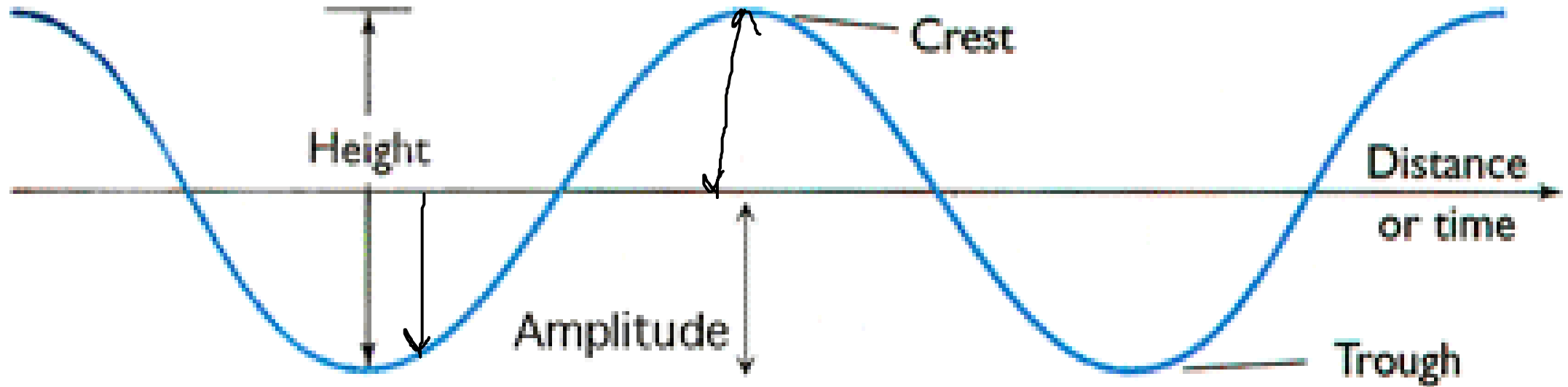
एक सेकंड में तरंग द्वारा लगाए गए चक्करों की संख्या को आवृत्ति कहते हैं आवृत्ति का मात्रक हर्टज होता है।

$$v = \frac{1}{T}$$

Speed (v), wavelength ( $\lambda$ ) and frequency (**v**) are related as  $v = \lambda v$



$T$   
Time Period



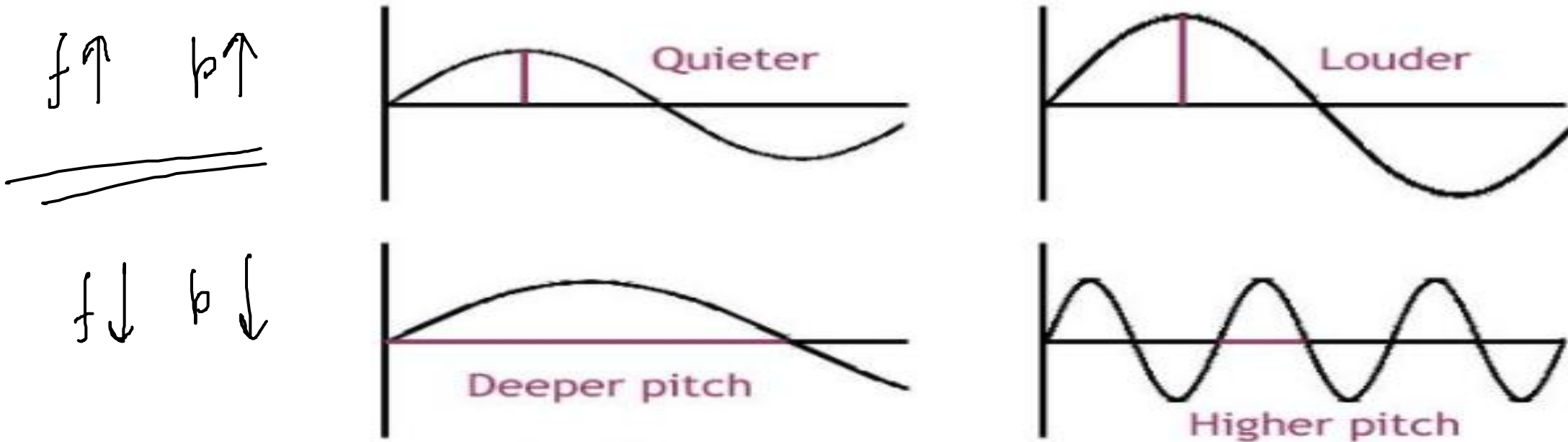


# • Pitch

The number of compressions or rarefactions per unit time. Directly proportional to frequency.

तारत्व ध्वनि का वह लक्षण होता है जिसके कारण कोई ध्वनि हमको पतली है मोटी सुनाई पड़ती है।

जैसे मच्छरों की भिनभिनाहट तथा लड़कियों की आवाज का पतला होना।



- **Speed of sound**

- Sound travels through different media with different speeds. Speed of sound depends on the properties of the medium: pressure, density and temperature

- **Speed of sound: Solids > Liquids > Gases**

- Speed of sound in air = 331 m/s at 0°C and 344 m/s at 22° C

-

- **Factors Affecting the Speed of Sound**

- **Density of the medium**

When the medium is dense, the molecules in the medium are closely packed which means that the force required by the molecules to vibrate is more. Therefore, the speed of sound decreases as the density of the medium increases.

- **Temperature of the medium**

The temperature of the medium and the sound waves are directly proportional to each other. Therefore, as the temperature increases, the speed of sound increases.

- **Speed of Sound in Gas**

We should remember that the speed of sound is independent of the density of the medium when it enters a liquid or solid.

Since gases expand to fill the given space, density is quite uniform irrespective of the type of gas.

This clearly isn't the case with solids and liquids.

**Table 12.1: Speed of sound in different media at 25 °C**

State	Substance	Speed in m/s
Solids	Aluminium	6420
	Nickel	6040
	Steel	5960
	Iron	5950
	Brass	4700
	Glass (Flint)	3980
Liquids	Water (Sea)	1531
	Water (distilled)	1498
	Ethanol	1207
	Methanol	1103
Gases	Hydrogen	1284
	Helium	965
	Air	346
	Oxygen	316
	Sulphur dioxide	213

- **Echo**

- The phenomenon where a sound produced is heard again due to reflection is called an echo.  
E.g: Clapping or shouting near a tall building or a mountain.
- To hear distinct echo sound, the time interval between original and reflected sound must be at least 0.1s.
- Minimum distance for obstruction or reflective surface to hear an echo should be 17.2 m.

- Audible and inaudible sounds
- Audible range = 20Hz to 20kHz known as the Sonic range.
- Below 20 Hz (inaudible) → infrasonic range
- Above 20 kHz (inaudible) → Ultrasonic range

# Ultrasonic sounds

- Ultrasonic sounds are high-frequency sound having a frequency greater than 20kHz (inaudible range).
- Applications of Ultrasound
- (i) Scanning images of human organs  
(ii) Detecting cracks in metal blocks  
(iii) Cleaning parts that are hard to reach  
(iv) Navigating, communicating or detecting objects on or under the surface of the water (SONAR).
- **$2d = v \times t$** . This method is called echo-location or echo ranging.

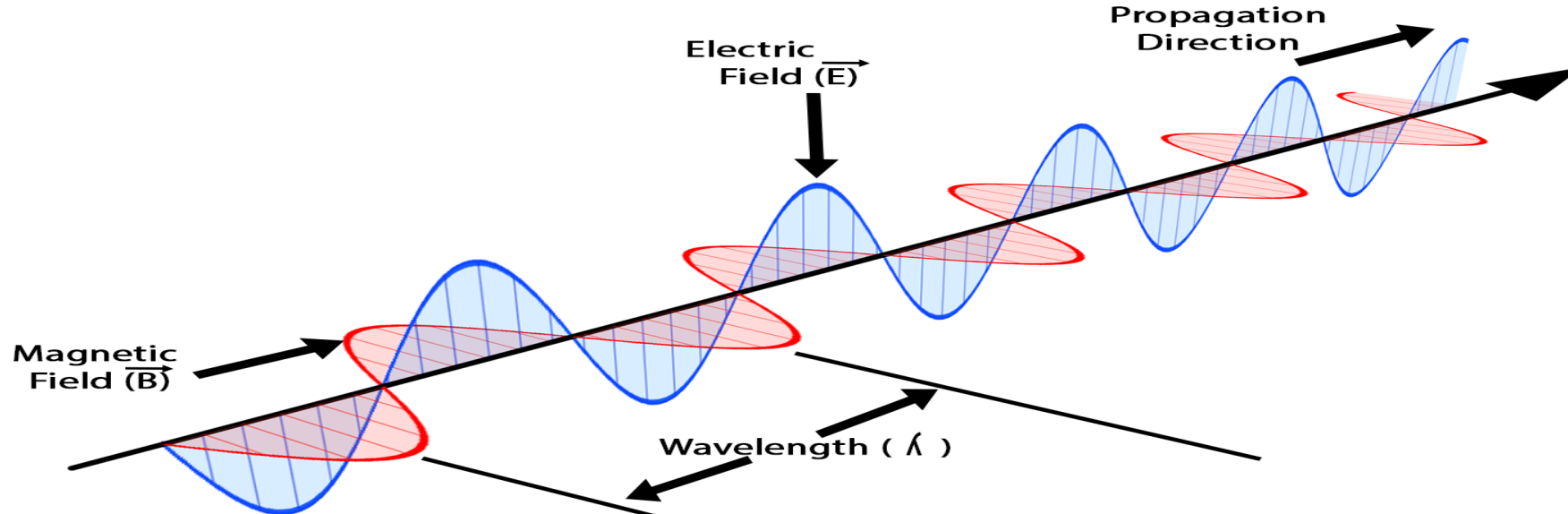


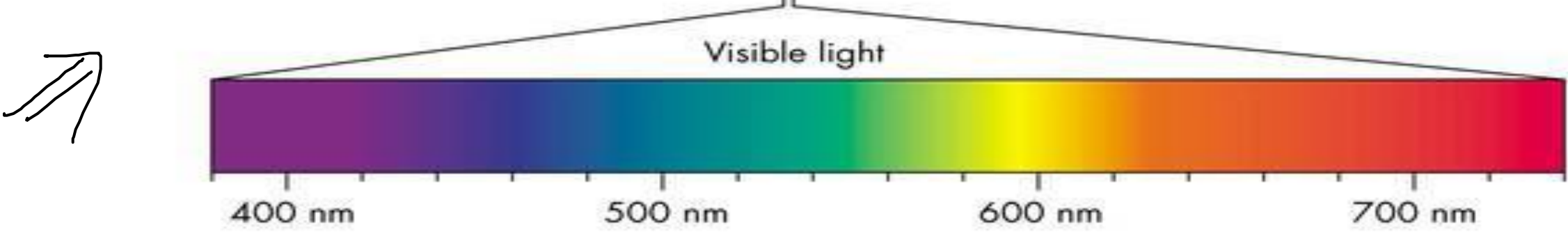
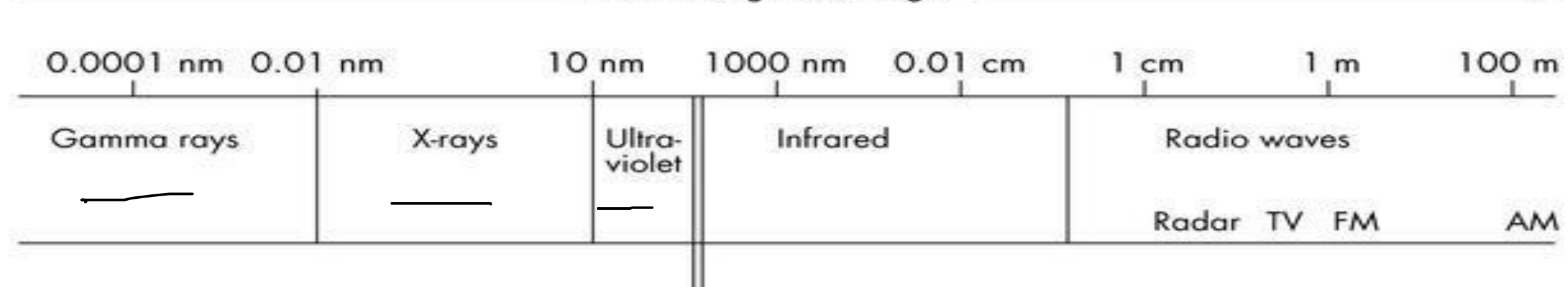
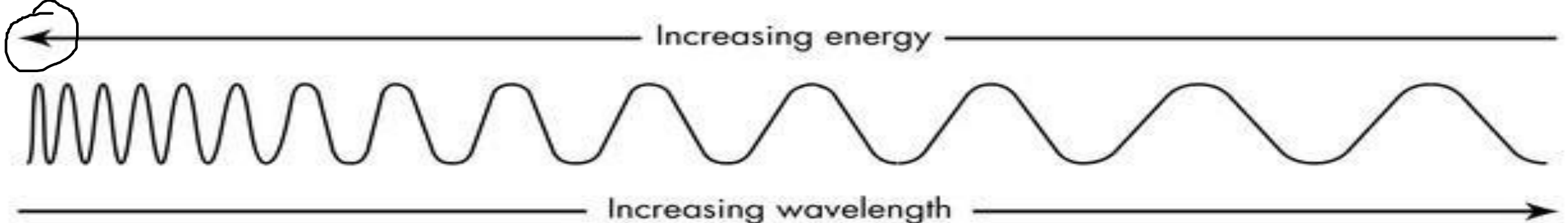
# ELECTRO MAGNETIC WAVES

- **Electromagnetic Waves**

Electromagnetic waves are those waves in which there are sinusoidal variations of electric and magnetic field vectors at right angles to each other as well as at right angles to the direction of wave propagation.

### Electromagnetic Wave





V I B G Y O R

$\lambda \downarrow$  —————  $\lambda \uparrow$

Handwritten notes below the visible light spectrum. The letters V, I, B, G, Y, O, R are written above the spectrum. Below them, a line with arrows at both ends is labeled with  $\lambda \downarrow$  on the left and  $\lambda \uparrow$  on the right, indicating the range of wavelengths.

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